Electrical World

A McGRAW-HILL PUBLICATION

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With The Edison Medal

FEBRUARY 15, 1947

Features

An Engineering Report of the AIEE Convention

Economics of Low Load Density Distribution – II

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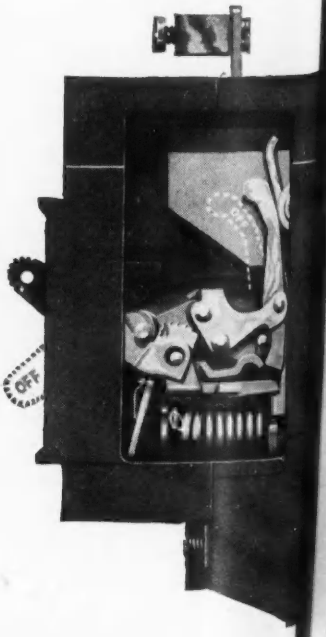

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February 15, 1947 **Contents** Vol. 127, No. 7

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Surrounded by television apparatus, Lee deForest, inventor of the grid controlled vacuum tube, receives the AIEE Edison Medal

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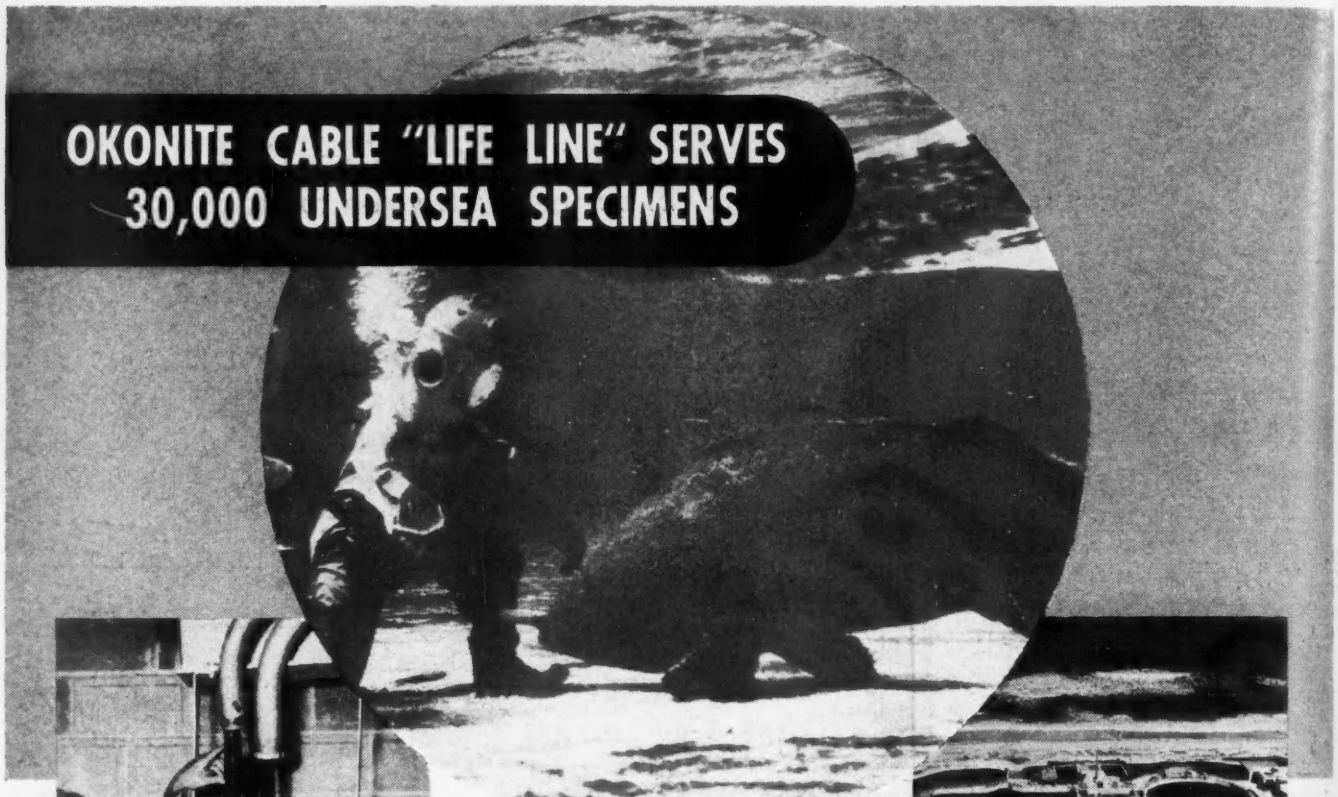

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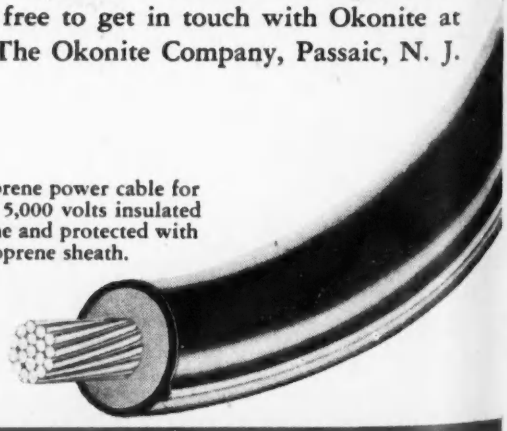

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INDUSTRY-WIDE BARGAINING...

Death Trap for Business, Suicide for Free Labor

IF CONGRESS is to succeed in its present efforts to prevent strikes in key industries from devastating the nation, it will have to put a crimp in industry-wide collective bargaining. This kind of bargaining is designed to apply agreements between employers and organized workers on wages and working conditions to an entire industry.

Further, if extension of this type of bargaining is not curbed, there is reason to believe that it will undermine the freedom of both American business enterprise and American wage earners. For, while increasing the destructive power of labor disputes, the general spread of industry-wide bargaining would so concentrate the fixing of wages—by far the largest element in the cost of production—that government regulation would be a next short step. With that step taken, freedom for business enterprise and freedom for labor would be well on the way out.

Unfortunately, industry-wide bargaining is commonly regarded as presenting a general conflict between organized labor and employers, with unions favoring it and employers opposed to it. This mistaken notion raises the heat of much of the discussion without increasing the light. The fact is there is no such general conflict. Employers and organized workers are on both sides of the argument about industry-wide collective bargaining. For example, while some union leaders are characterizing as labor baiters all those who raise the slightest question as to the desirability of industry-wide bargaining, organized workers in the air transport industry are strenuously opposing that type of bargaining; and the employers are advocating it.

Some Employers Like It

The reason there is in fact no clear cut issue between employers and unions over industry-wide bargaining is readily understandable. It presents certain advantages to both sides in the bargaining process. For example, union advocates of such bargaining generally stress the fact that industry-wide agreement on wages protects wage standards from being undercut by lower wage areas and lower wage employers. By much the same token, however, employers who like it often emphasize the fact that industry-wide bargaining may save certain well-managed and prosperous companies from being singled out for particularly heavy wage exactions. This general point has been underlined in both the full-fashioned hosiery industry and the West Coast paper and pulp industry. There, local unions, affiliated with international unions, have protested that industry-wide collective bargaining prevents them from getting from especially prosperous employers wages as high as they could get if allowed to go it alone in collective bargaining.

So long as employers remain subject to the federal antitrust laws while unions are exempted, the balance of power in industry-wide bargaining would seem to be heavily weighted on the side of the unions. If, for example, employers were to announce an intention to match an industry-wide wage increase by an industry-wide price increase, there is no doubt that they would promptly be indicted for violation of the federal antitrust laws. Even so, the fact remains that some employers favor industry-wide bargaining while some segments of organized labor are against it.

A Clear Cut Public Issue

The industry-wide bargaining issue as it affects the public, however, is clear cut. It is concentration of economic power (in the hands of both unions and management) which can make industrial conflict devastating to the public welfare. At least five times within about a year—in steel, on the railroads, in the maritime industry and twice in the soft coal industry—strikes prompted by union efforts to impose industry-wide agreement about wages and working conditions have paralyzed large parts of the nation's economic life.

In soft coal about 90% of the production workers are members of the United Mine Workers. In steel

about 80% of the production workers are members of the United Steelworkers, C. I. O. In some other key industries there is a comparable degree of concentration of union control. In the face of such concentration many employers see no alternative but to get together on their side for industry-wide bargaining. But when they do so in key industries, the odds are lengthened that failure to agree on wages and related matters, will result in generally ruinous conflict. If agreement is reached, the chances are increased that it will take too little account of the welfare of the consuming public.

It is possible to have industry-wide bargaining on many subjects other than wages. *But the main interest is wages; and the main drive is toward industry-wide and ultimately nation-wide uniformity. Such uniformity is the deadly enemy of industrial decentralization and the pioneering expansion of industry in new areas.* Why pioneer, with inexperienced workers, if the wage rate must be uniform for the whole industry? Moreover, it would also be hard to conceive of a more effective way to put a blight on local efforts to improve industrial relations than to make wage rates and other working conditions uniform throughout the industry and then the nation. *However, among many other dangers, the overshadowing danger in industry-wide bargaining lies in its concentration of economic power.*

Wages Monopolized

On the average, the cost of labor accounts for about two-thirds of the total cost of all industrial products. The universal spread of industry-wide bargaining would thus concentrate in relatively few hands control of the greater part of the cost of industrial production. There is no reason to believe that even without disastrous strikes, such concentration would long continue free from government regulation. That would turn more earth for the graves of American business enterprise and American working men's freedom.

Those who believe that industry-wide bargaining serves the public well—and many sincere people do —stress the fact that, on the whole, it has worked in the industries where it has been tried over a considerable period. Most of the industries of which this is true, however, are not key industries. The pottery industry, the glassware industry, and the silk and rayon dyeing industry—to cite a few in which industry-wide bargaining has been practiced with considerable success—are important industries. But they are not industries in which strikes would have a ruinous impact on the nation. In contrast, a strike in the soft coal industry as the result of a breakdown of industry-wide negotiations quickly becomes a national disaster. The dangers inherent in industry-wide bargaining are multiplied accordingly.

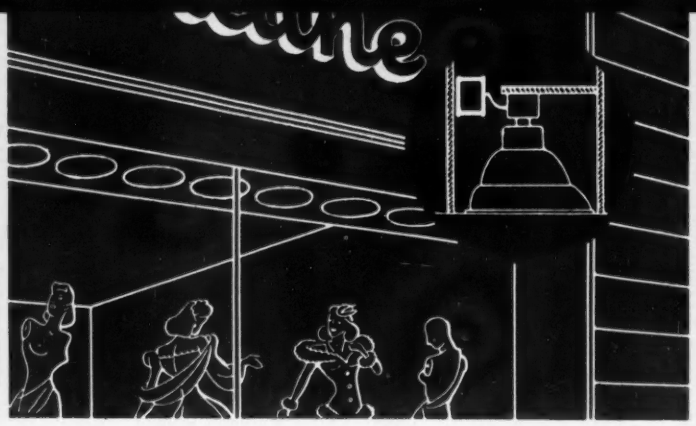
England No Guide

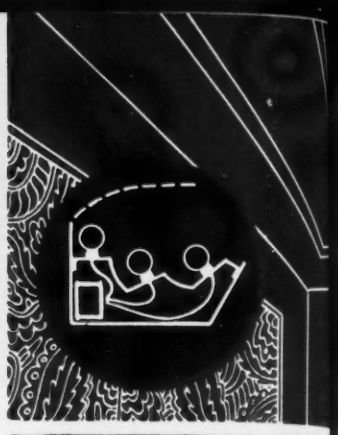
Those who think extension of industry-wide bargaining would be good for the public often emphasize the fact that it has worked smoothly in England, where it has been extensively practiced. *Not the least of the things it has smoothed in England, however, is the transfer from private enterprise to state socialism of industries in which industry-wide bargaining by monopolistic unions and employer groups had so badly undercut competition that private enterprise had lost much of its justification.* A general extension of industry-wide bargaining could be expected to have the same consequences in this country.

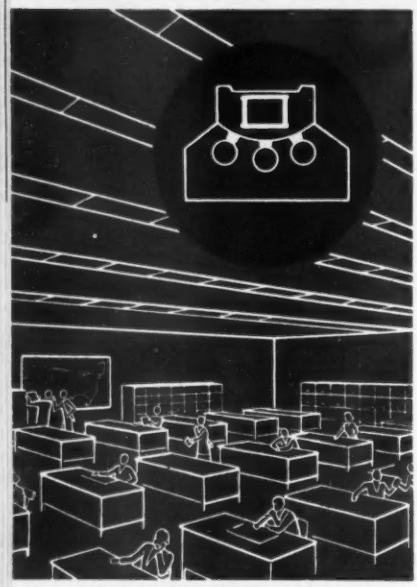
The best way to curb industry-wide bargaining is a question which lies beyond this discussion. *Much would be accomplished if the federal government would discontinue its active promotion of industry-wide adjustments, in the fields of both labor and management, at which it has been busy ever since N. R. A. days. Still more would be accomplished if the federal antitrust laws were applied with even-handed justice both to unions and employers—a course urged in the 53rd editorial in this series.* Perhaps a definite limitation of the scope of labor agreements would also be necessary.

The effects of industry-wide bargaining in increasing the extent of public regulation of industry will vary. They will, of course, be less pronounced in railroads and other public utilities, which are already extensively regulated, than they will be elsewhere. For unregulated industries, however, industry-wide bargaining carries the threat of extensive regulation and, along the way, of industrial conflict devastating to the public. In these excited times, to say what I have said here is to invite characterization by overheated partizans as a foe of legitimate union progress. That is perhaps not so bad, however, as to qualify as a pall bearer for both American business enterprise and some of the basic freedoms of American working men. That may well be the fate of those who blindly accept the expansion of industry-wide collective bargaining as being "in tune with the times."

President McGraw-Hill Publishing Company, Inc.







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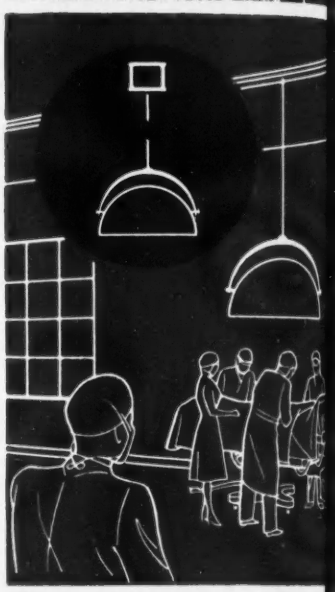

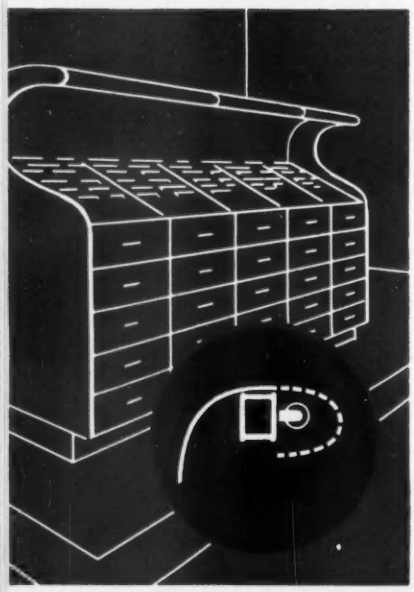

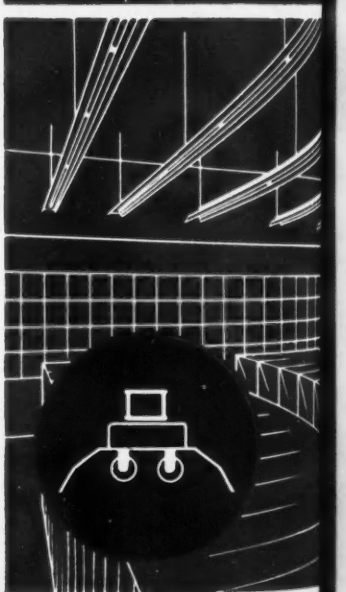

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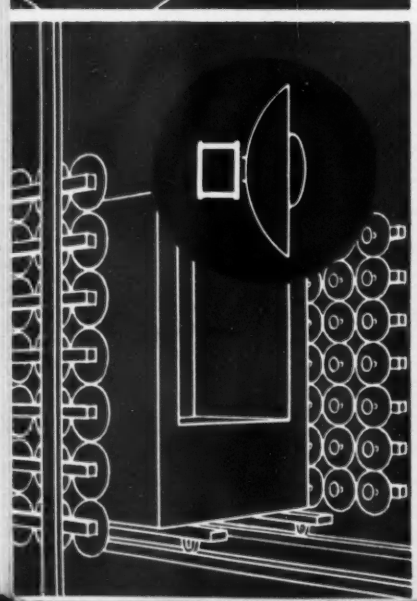
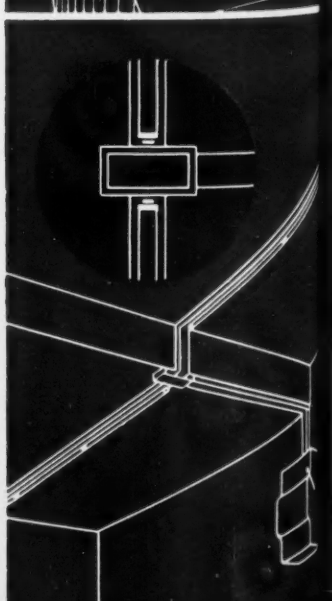




Electrical World

FEBRUARY 15, 1947

Needed . . . The Right Industry Decision

ITS MEMBERSHIP organized and apparently assured of Senate confirmation, the Atomic Energy Commission is in business. This is a major step in the history of our government.

It is unpleasant to contemplate the possibilities inherent in an organization of this type. Its powers are appallingly broad. Its membership is appointive, not elective. Its sphere is bewildering even to well-educated men. It operates a nationalized industry. Its business must be clothed with a secrecy repugnant to American traditions. Almost no major policy decision may be made until it is known that there will or will not be effective international atom control and what its dimensions will be.

To the electric power industry, the picture is even darker. Under existing law, up to half of all atomic-electric power output will have to be publicly produced unless AEC wants to throw away as many Btu.'s as it makes available through the production of fissionable materials for atomic-electric power reactors.

All these considerations are beyond control. Unpleasant or not, they exist, in the law and in the general scheme of things. They may be called the service charge of the atomic era.

It appears that additional unpleasant factors are entering the electric power industry's contemplation of the new order. At least some industry people are actively unhappy about David E. Lilienthal's membership on and chairmanship of the commission.

Those who fear Lilienthal in his new capacity can do so only on the assumption that he will use his new position to continue the war against private ownership. Demonstrably, his new position *could* be used to this end even more effectively than his directorship of TVA. To assume that it *will* be so used is to assume that the man is completely unaware of the existence of the atomic era. The record of the last 18 months ridicules any such assumption.

It is unfortunate that there has never been published a secret report from Lilienthal to the late President Roosevelt, dated January 11, 1943. This report defeated the last serious attempt to place control of war power supply firmly in the hands of the public ownership extremists. Whatever his motivation, Lilienthal saved the day for private power with that report. The point is important as a demonstration that Lilienthal can rise above ownership ideology.

It is AEC policy to obtain the widest possible industrial participation in all its disclosable programs. To disseminate permissible atomic "know-how," industrial firms under contract to AEC will be required to use men from other companies. Another device will be the adaptation of WPB's war-time industry-advisory committee system. Lilienthal has testified that an advisory group will be organized for the atomic-electric program, including "utility men."

The membership of such group, and the extent to which it be permitted to function, should provide a reasonable test of AEC's intentions toward private power. Until it is demonstrated that the atom is to be the tool for final and complete nationalization of electric power, the industry need not throw up its hands on AEC.

★ ★ NEWS OF THE

Private Industry to Play Part in Atomic Energy Research

Utilities, Electrical Manufacturers and Engineers Will Serve AEC in Advisory Capacity—Industrial-Professional Groups Will Also Work with Private Operators of Projects

BROAD PARTICIPATION of private industry, including public utilities and electrical manufactures and engineers, in atomic energy research has been scheduled by the Atomic Energy Commission, it was learned this week.

Present plans of the commission call for the formation of separate industrial-professional groups to work with the private organizations under contract to operate the several nuclear fission research projects and with AEC itself in a topside advisory capacity.

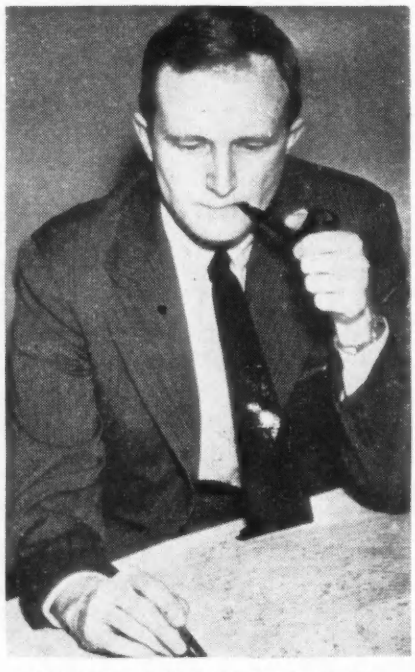
The pattern for advisory groups at the research project level already has been established in connection with the Monsanto Chemical Co.'s contractual activities at the Clinton Laboratories.

The following firms and individuals have been named to serve as consultants to Monsanto: American Gas & Electric Co., Commonwealth Edison Co., Consolidated Edison Co., Detroit Edison Co., Philadelphia Electric Co., Air Reduction Sales Co., Allis-Chalmers Manufacturing Co., Babcock and Wilcox Co., F. H. Colvin Co., Combustion Engineering Co., Dr. Farrington Daniels of the University of Wisconsin, De Laval Steam Turbine Co., Frederick Flader Inc., General Electric Co., National Carbon Co., Inc., Northrop Aircraft Co., Purdue University, Westinghouse Electric Corp., Foster Wheeler Corp., J. E. Willard of the University of Wisconsin, Wright Aeronautical Corp., and J. I. Yellot of the Locomotive Development Committee.

Personnel of Allis-Chalmers, Babcock & Wilcox, Combustion Engineering, Flader, General Electric, Northrop, Wright Aeronautical and Westinghouse are serving as staff members of the Clinton Laboratories. Additional personnel for this project also has been supplied by the Tennessee Valley Authority, the Navy's Bureau of Ships, National Advisory Committee for Aeronautics, and the Universities of Chicago, Purdue, and Wisconsin.

Both the consultant group and the industrial staff of this project are scheduled for expansion in the near future. Similar bodies also will be set up to serve at the Knolls Laboratories at Schenectady, which are being operated by General Electric.

Eventually, AEC plans, all industries whose activities are affected by developments of nuclear research probably will be represented by consultants at individual experimental projects or affiliated with the commission.



ATOMIC RESEARCH DIRECTOR—**James B. Fisk, industrial physical research expert of Concord, Mass., who has been named by the Atomic Energy Commission to direct its Division of Research**

Selection of private utility consultants in connection with the Clinton Laboratories and indications that the utilities will be represented in similar bodies which will work with General Electric at Schenectady are considered especially significant. Monsanto and General Electric are working on the development of electric energy at these projects.

AEC has decided against manning its experimental laboratories directly with federal workers and is not authorized to set up quasi-public corporations of the TVA or RFC type. Its establishment of advisory groups at two levels is seen as an effort to avoid certain hazards which might result from its system of contracting with private industries to operate its plants and laboratories on a non-profit basis. This system, AEC feels, might lead to the narrowing of the field of qualified technicians on which it must rely and to the creation of monopolies in the various phases of nuclear development.

The advisory groups will work closely with AEC's contractors, with the power to recommend definite programs of atomic research. Industrial advisory organizations to serve with the commission itself probably will be patterned after the advisory committees created by the War Production Board.

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Energy Production Hits New High in December '46

Establishing a new high monthly record, production of electric energy for public use during December, 1946, totaled 20,809,162,000 kw.-hr., according to a report issued by the Federal Power Commission. This represents an increase of 14.9 percent over December, 1945. Combined utilities and industrial production was 24,849,148,000 kw.-hr. during December, an increase of 12.9 percent above December, 1945.

Average daily production of electric energy for public use in December was 732,717,000 kw.-hr., an increase of 0.3 percent in comparison with the average daily production during the previous month, and an increase of 14.5 percent over December, 1945. Production by water power in December amounted to 6,550,229,000 kw.-hr., or 31.5 percent of the total output for public use, according to the report.

ELECTRICAL WORLD ★ ★

Atomic Power Workers to Get Intensive Training

G.E. Engineer from Hanford Plant Says Operating Crew Will Need 3 to 6 Months' Special Training

Months of intensive training will be required to train engineers who will control the atomic, or "nuclear" power plant of the future, C. P. Cabell, chemical engineer at the Hanford Engineer Works of the General Electric Co., Richland, Wash., recently told the San Diego, Calif., chapter of the American Institute of Electrical Engineers.

He pointed out that operating crews of atomic power plants would receive three to six months' training either in a plant already in operation or under a "start-up" crew. This period of training will be completed before the crew actually takes over operation of a plant, Cabell stated.

In describing what the engineers visualize as the atomic power plant of the future, Mr. Cabell said that it will consist of the so-called "pile area" where atomic power is produced, electrical generating area, a chemical separations area for working over the atomic fuels, and a building in which will be housed the "United Nations Inspection and Research Laboratories."

UN Staff Will be Large

Cabell predicted that the occupants of the latter building will be highly trained technical personnel including a chief inspector, a dozen Ph.D.'s, about 30 junior physicists, and a full complement of laboratory helpers. A tour of the facilities with which these men work would reveal complete facilities for chemical, biological and nuclear research.

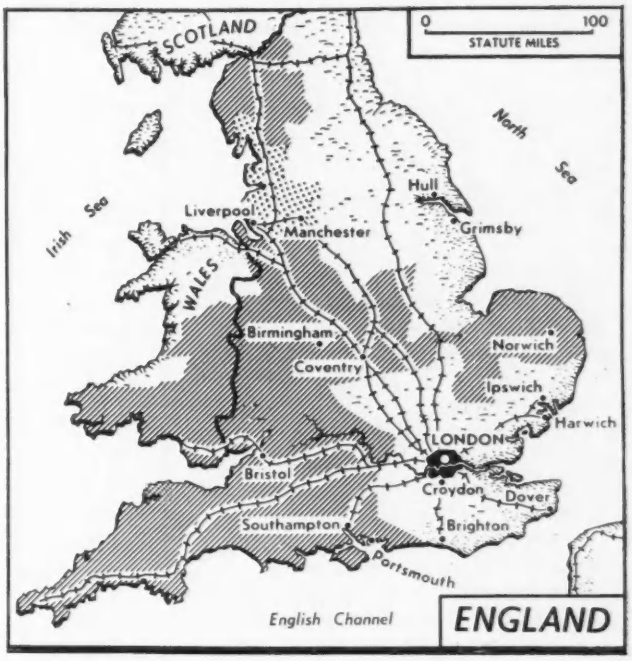
Detecting any possible attempts to evade or circumvent the rules laid down by the United Nations for the control of atomic energy's use will be the chief concern of these laboratories located at each of the atomic power plants of the future.

Each plant will have its "health instrument engineers" whose job will be to check the areas carefully with instruments which detect radiations, to find potential hazards. Such men will have to be on duty on every shift. They will make very strict rules to prevent anyone's receiving more than one-half of his tolerance dose of radiation.

Mr. Cabell said the lost-time accident rate at Hanford Engineer Works, an atomic power plant, is only 13.63 lost-time accidents per million man-hours.

"This figure of 0.67," he added, "may be compared with the rate of 13.62 accidents for all American industry in 1945. In electric utilities the rate is 13.44, in communications, 2.97, and even for office employees in hazardous industry in the State of Washington, the rate is 1.1. As a matter of fact, the atomic power industry is the safest industry in America."

NO POWER—Faced with extreme shortages of coal despite government ownership of the mines, England's Labor government has curtailed the use of electricity in most industrial sections. Only essential industries have been permitted to continue operating. There is no electricity for home use between 9 a. m. and noon and 2 and 4 p. m. Striped areas are affected. Dotted area may be exempt



Long Weekend Not Lost

The advantages of a "long weekend" are not lost to employees of the New York Power & Light Corp. In an agreement recently signed between the corporation and the United Mine Workers, District 50, Washington's birthday anniversary is designated as a February holiday except when a longer weekend would result from the observance of Lincoln's birthday anniversary.

California-Oregon Power Gets Hydro-Plant License

A license for construction of a $3,500,000 power plant on the North Umpqua River in Douglas County, Ore., has been granted by the Oregon Hydro-Electric Commission to the California-Oregon Power Co.

Plans for the project call for utilization of a maximum of 850 cu.ft. of water per second to operate a power plant with an installed capacity of 25,000 kw. A 40-mile transmission line will connect the project with the main system of the California-Oregon Co. at Dixonville, near Roseburg.

The diversion dam will have a crest length of 350 ft. It will be of earth construction, with a concrete-lined spillway. Water will be carried from the dam to the power plant through 880 ft. of 9½-ft. wood stave pipe, 5,600 ft. of concrete-lined tunnel and 1,500 ft. of steel pipe. The power house, of steel and brick construction, will cover two vertical reaction turbines which will operate under an effective head of 405 ft. These turbines will connect with two a.c. generators, each of which is rated at 12,500 kw.

Generated energy will be stepped up to 138 kv. for transmission to the Dixonville interconnection.

Arbitration Board Announces Duquesne Light Case Awards

Workers Get Pay Raises of 5 to 18 Cents an Hour, Extra Holiday, Increased Vacations, and Other Benefits—Union Fails to Get Master Contract, Union Shop, Profit Sharing

FIFTY-EIGHT AWARDS—only 13 of them unanimously approved—were made by the three-man arbitration board which resolved differences between the Duquesne Light Co. and its affiliates and the Independent Association of its employees.

The awards, announced last week, were in settlement of more than 100 issues on which evidence was presented in the 25 days of hearings.

They included:

1. Pay boosts ranging from 5 to 18 cents hourly, with Duquesne hourly or outside workers receiving 15 cents and its salaried employees 13 cents.

2. Denial of a union shop, a master contract covering all nine contracts, and of the inclusion of supervisors in bargaining units.

3. Limited extension of "benefits," including one additional regular holiday (14 had been asked), increased vacations and call-out pay, a limited service bonus, payment by the company of half of the cost of hospitalization plans, and a bonus to certain night employees.

4. Denial of a separation allowance, travel time, a night differential, and a profit-sharing proposal.

5. Strengthening of the no-strike clause and grievance procedure.

6. Maintenance of Duquesne's Engineering and Construction Department.

7. Provision for reopening wage negotiations after next August 1 if the city's cost of living index rises or falls 10 points from a stipulated level.

Awards Are Binding

Duquesne Light Co. immediately announced that the awards were binding and will be put into effect as quickly as possible. George L. Mueller, union president and its representative on the arbitration board, termed the decision "unsatisfactory" but "final and binding."

Mueller failed to sign 30 of 58 awards, including that relating to wage boosts. Company representative Maurice R. Scharff failed to sign 15. Chairman George E. Strong signed all awards.

In opinions accompanying the awards, both Scharff and Strong expressed scepticism regarding possibilities of future peace between Duquesne and its affiliates and the union. Strong asserted the "perhaps vain hope that good labor relations will result" and added that "eventually, recognition of responsibility must come."

Scharff, a New York consulting engineer, argued that many of the issues before the arbitrators "are of the type that can be handled satisfactorily only by collective bargaining," and added:

"I have grave fears that these awards, instead of simplifying and clarifying the relations between the companies and the union, may actually lead to further misunderstanding and may increase instead of decrease disputes and grievances."

Scharff assailed failure of union officials to bargain in good faith and to work for acceptance by the membership of agreements reached by negotiators.

Commenting upon the denial of the union shop despite union insistence that it would stabilize relations, Chairman Strong cited past performance of the union.

"There were strikes in violation of the agreements," he asserted, "and the union and some of its leaders disregarded their signed obligations to the public and the companies This union does not qualify at this time for assistance from the employers or this board in its desire for more power, more dues, more assessments, more initiation fees, and greater security."

Commenting upon a union argument that "wages and employee privileges should be more than in non-utilities," Strong asserted that "this presupposes that the employees were refraining from striking in return for these special privileges. Obviously this argument does not apply where the employees have not only engaged in strikes in violation of the contract during 1943, 1944 and 1945, but even refused to arbitrate from early in September until the last of October in 1946 and also engaged in a 27-day strike during that period."

Strong said that testimony by three actuaries for insurance companies "which would be interested in selling more expensive pension plans" had described the union's pension request as "preposterous." The union plan called for pensions of $100 monthly after 20 years and $400 after 30 years, all costs to be borne by the companies. The actuaries, Strong continued, "testified that they could not recommend and would not write such a plan as the union proposed as it was too expensive." They added that the existing plan, due to interest rate declines, "paid pensions in the middle group and slightly below the average of the industry and was therefore a fairly average but not liberal plan."

Strong's opinion added that company expenditures, not including taxes, for employee benefits now average $213 to $450 per employee per year.

More Utility Strikes

The extent and severity of strikes in electric power and other public utilities in 1946 is indicated by a report of the Bureau of Labor Statistics for the first ten months of the year.

In 1945 the heat, light, and power utilities were hit by 13 strikes involving 3.500 workers who were idle 14,000 man-days. In the first ten months of 1946, the same utilities were hit by 18 strikes involving 6.700 workers who were idle 49,000 man-days.

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Cleveland Electric Rate Cut Barred by Ohio P.S.C.

The Cleveland Electric Illuminating Co. has won its fight with the City of Cleveland to maintain its present electric rates as a result of a decision of the Ohio Public Utilities Commission holding that an ordinance passed in May, 1944, reducing rates to be "unjust and unreasonable."

Following passage of the ordinance, the company appealed and has continued to collect its former rates but has impounded the excess over the reduced rates ordered. Approximately $3,400,000 has been impounded, but this is subject to federal income taxes. The amount impounded includes monies collected in some 80 other communities served by the company; these had made an agreement with the utility that if the ordinance were approved the same rates would apply to their residents and would be made retroactive.

The original ordinance was for a two-year period but was reenacted in 1946. This second ordinance is still on appeal but is not likely to be approved.

Cooking Equipment for Vet Hospitals Starts Controversy

Electric Utilities, Contractors, and Manufacturers Protest to War Department That Policies of Engineers Will Give Gas Utilities All of Cooking Load in 90 Vet Hospitals Now Planned

A DISPUTE is brewing over the type of cooking equipment—electric or gas—to be installed in some 90 veterans' hospitals now scheduled for construction. Already involved are the Veterans Administration, the Army Engineers, the National Electrical Contractors Association, Edison Electric Institute, and electric utilities and manufacturers.

Representatives of at least one utility and NECA have protested to the War Department against certain policies which they claim will prevent installation of electric ranges in any new hospitals. These policies, followed by the Engineers in planning hospitals, set standards for selection of cooking equipment for hospitals throughout the country.

They direct district engineers to consider cost of fuel, cost of equipment and installation, and amortization and interest on investment. Consumption costs are estimated on the cost of fuel used per person per day as follows: natural gas, 9 cu. ft.; manufactured gas, 15 cu. ft.; electricity, 1 kw.-hr. Equipment, both electric and gas, is amortized over ten years with interest at 2 percent. Cost of ranges is estimated at $1.87 per bed for gas and $2.81 for electric.

When a project is submitted, the district engineer is to investigate service by utilities and, using the formulas above, determine whether gas or electricity is more economical. This study is subject to approval by the Chief of Engineers.

Representatives of the Chief of Engineers said the standards were prepared by the Veterans Administration and were based upon cost and use studies in existing hospitals. They admitted that certain of them, especially those established for consumption, appear "out of line."

The Engineers, in cooperation with several utility companies, are reexamining these standards and plan to make "any necessary revisions" soon. Results of this study will be submitted for rechecking to the U. S. Bureau of Standards.

Meanwhile, E.E.I. also was reported studying equipment standards as a result of complaints by electric utilities and manufacturers.

VA officials reported that responsibility for selecting cooking equipment, as well as methods of economic analysis, had been "completely delegated to the Chief of Engineers."

War Department spokesmen denied that the standards would prevent electric installations. They said electricity now is used for cooking about equally with gas. Rates will be a major factor in selecting fuel, they declared.

Electric utility and manufacturers' representatives insisted, however, that selection of fuels solely upon a cost basis under existing standards would eliminate future use of electricity. They attacked especially the 1 kw.-hr. per person per day consumption figure as being nearly triple the actual rate. Equipment costs are calculated too high, and electric equipment should be depreciated over 20 years, they added.

BLASTING FOR WATER—Employees of the Niagara Falls Power Co. stand at a safe distance as they blast a 30-ft. thick wall of ice in the Niagara River above the falls to improve the flow of water during the recent cold wave

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Thomas H. Hogg Resigns as Head of Ontario Hydro

Dr. Thomas H. Hogg, since 1937 chairman of the Ontario Hydro-Electric Power Commission and its chief engineer, has resigned giving ill-health as the reason. His resignation has been accepted by George A. Drew, prime minister of Ontario, as of February 28.

The resignation of Dr. Hogg, who has been in the employ of the commission since 1913, followed a request by the prime minister that he resign because of his persistent refusal to communicate "essential information" to the Ontario government.

Prime Minister Drew based his demand on charges that the government had not been informed of the steps taken by the commission to purchase the assets of the Ottawa Light, Heat & Power Co. and of a proposal of a subsidiary of the Niagara Hudson Power Corp., Syracuse, to supply the commission with 100,000 hp. of energy needed to avert rationing of electricity.

Dr. Hogg was accused by the prime minister of not telling anyone of the American company's offer, leaving everyone with the impression that rationing could not be avoided, and then going to Bermuda for a lengthy vacation. During his absence, the other members learned of the offer and accepted it.

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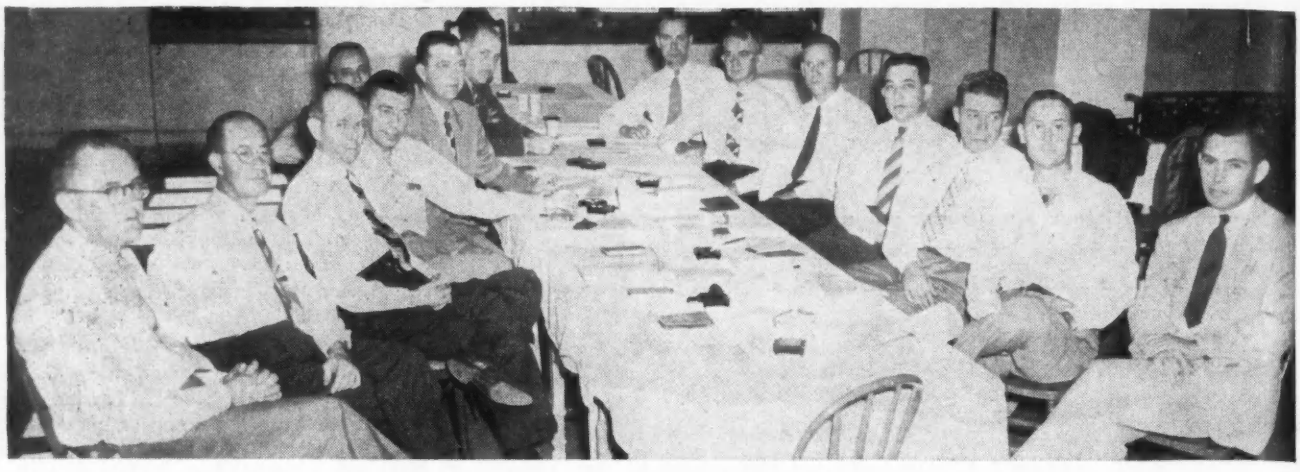
New P. U. C. President

Bert Auger has been named president of the Idaho Public Utilities Commission to succeed John Cornell. The presidency of the commission is rotated every two years.



METERMEN'S EXECUTIVE COMMITTEE—Members of the Southeastern Metermen's Association Executive Committee meet to plan the 22nd Annual Short Course and Conference on Electric Meters which will be presented by the University of Florida, May 5-9. Left to right, E. F. Smith, University of Florida, course supervisor; E. E. Doudna, Electric Power Board of Chattanooga, Association vice-president; B. Z. Segall, New Orleans Public Service, Inc., Association president; W. A. Keller, Westinghouse Electric Corp.; G. A. Hoffman, Sangamo Electric Co.; Carl P. Owens, Walker Electric Co.; W. V. Gearhart, Walter V. Gearhart Co.; J. B. Clark, City of Jacksonville, Fla.; J. L. Sheppard, South Carolina Public Service Authority; R. O. Bushnell, Florida Power & Light Co.; R. H. Fleming, Sangamo Electric Co.; C. G. Holler, Mississippi Power & Light Co.; C. R. Randolph, and V. B. Nolan, Florida Power & Light Co.

Georgia Power Gets P.S.C. Order to Cut Co-op Rates

The Georgia Public Service Commission has ordered a rate reduction on power sold by Georgia Power Co. to the REA cooperatives in the state. The reduction will save the co-ops $66,810 a year, or 12.3 percent under former rates.

The commission stated that the co-ops had complained of the complexity of the former schedule and that, following a survey of 101 different wholesale rates throughout the country and conferences with utility officials, the new rates were agreed upon, thereby saving time and expense of a formal hearing.

The commission found that of the 101 schedules, it was impossible to apply eight by reason of special provisions, but of the 93 remaining rates, only 18 were found to be lower than the present Georgia Power rates, two were the same, and 73 were higher, and several of the 18 lower rates were those of public power agencies. The rate is one of the lowest in the country and only 18/100 of a mill per kw.-hr. above the TVA rate.

Under the proposed rate, Georgia Power will continue to furnish substation equipment. The company will maintain a competitive relation between the co-op and industrial rates. The rate includes a charge of $1.11 per kw. of maximum demand of large use customers of co-ops with a 50-hp. or more load.

The gross rate is 1 cent per kw.-hr. for the first 17,500 kw.-hr. per month and 0.722 cents per kw.-hr. over 17,500 kw.-hr. For service resold by the customer to any single load of 50 hp. or more, an additional charge of $1.11 per kw. of maximum demand is made. Gross minimum monthly charge is $1.66 per kw. of billing demand at each separate metering point. All bills are subject to a 10 percent discount for payment within ten days.

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Santa Fe, First U. S. Road, to Purchase Gas Turbine

The first commercial order ever placed by an operating railroad in the United States for a gas turbine has been announced by the Atchison, Topeka & Santa Fe R. R. The turbine will be installed in an oil-burning passenger locomotive which was designed by engineers of the Baldwin Locomotive Co., the Santa Fe, and the Elliott Co. The locomotive will cost $500,000 and will develop about 3,000 hp.

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H. Hobart Porter Dies

H. Hobart Porter, chairman of the board of the American Water Works & Electric Co., New York, died on February 9 at his home in that city after a long illness. He was 81 years old. It was largely through the efforts of Mr. Porter that American Water Works was organized in 1914 out of its defunct predecessor, the American Water Works & Guarantee Co. Mr. Porter assumed the presidency, which he retained until 1937, when he was appointed board chairman.

Utility Industry Efficiency Rose Greatly Since 1899

The great improvement in efficiency of electric utilities between 1899 and 1942 has been revealed in a new study published by the National Bureau of Economic Research. The study has been issued in book form under the title, "Output and Productivity in the Electric and Gas Utilities, 1899-1942." Its author is Dr. Jacob M. Gould, an economic consultant formerly on the staff of the National Bureau.

The report finds that between the opening of the century and the outbreak of World War II the output of the electric utility industry multiplied 40 times. This rapid rise in utility output, proceeding at an average annual rate of about 8 percent per year in the period considered, was accompanied by increased consumption of labor, fuel, and capital, but these components of input all lagged far behind output.

In electric power plants the number of persons employed per unit of product was reduced by four-fifths, and the number of pounds of coal (or coal equivalent of other fuels) consumed per kw.-hr. generated declined by five-sixths.

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190,000-Hp. Unit Planned

Indiana & Michigan Electric Co. will spend $15,000,000 to add a 190,000-hp. unit to its Twin Branch steam plant east of Mishawaka, Ind., which now has a capacity of 323,601 hp. The new plant will not go into operation until 1949.

Lilienthal Hearings Continue; Opposition Gaining Strength

Arthur E. Morgan, One-Time Chairman of TVA, Testifies against Nominee for Chairmanship of Atomic Energy Group —Denial of Confirmation May Lead Rest of AEC to Quit

THE MAN he forced from chairmanship of the Tennessee Valley Authority almost a decade ago—Dr. Arthur E. Morgan—told a Senate Committee this week that David E. Lilienthal should not be confirmed for chairmanship of the Atomic Energy Committee.

Morgan shared the stand with War Secretary Robert E. Patterson, who was as categorical in Lilienthal's defense as Morgan was in opposition to him.

Their testimony came as Washington began increased speculation on the results of the political fight into which the confirmation hearings have developed. With two additional Republican Senators openly against him, and with rumors that G.O.P. Senate Leader Taft would oppose Lilienthal, possibilities that he might fail of confirmation had increased substantially. The odds, however, still favor confirmation. Only rarely does the Senate refuse confirmation.

Lilienthal Won't Withdraw

It was known that Lilienthal would not withdraw, and reliable sources indicated that there is now no possibility that President Truman will withdraw the nomination.

One informed source indicated that should Lilienthal be refused confirmation, there could be little doubt that those appointed with him to the commission would resign also.

As hearings on the confirmation of the commission went into their third week, some of the most imposing testimony possible was presented in favor of General Counsel Herbert S. Marks. Although not subject to Senate confirmation, Marks was made the subject of considerable testimony because he had been charged with activities linking him with persons suspected of being Communists.

Undersecretary of State Dean Acheson opened the pro-Marks testimony, which included some yet-undisclosed telegrams from prominent utility leaders who knew Marks during his days as general counsel and, for a time, director of the Office of War Utilities and its predecessor agencies.

Acheson, whose assistant Marks was after leaving OWU, described Marks as having "excellent, calm, broad judgment" and "great ability."

"He is a man of the highest character and integrity," Acheson asserted.

John Lord O'Brian, formerly chief counsel of OPM, SPAB, WPB, was limitless in his praise of Marks' ability and in his denial of any Communist leanings.

"I know this man intimately," O'Brian declared. "Any suggestion that he is a Communist or has Communist tendencies, or has subversive tendencies, is just sheer nonsense. Now I say that with a full understanding of what I am saying."

O'Brian testified that he has authorization from Philip D. Reed, chairman of the board of General Electric Co.; William L. Batt, president of SKF Industries; and a number of other prominent industrialists, to say that they agreed 100 percent with what he (O'Brian) testified about Marks.

Walker L. Cisler, chief engineer of power plants for Detroit Edison Co., also testified in unrestrained praise of Marks' ability and character. He ridiculed any assumption that Marks could have Communist tendencies.

Planned Lighting Contest Announced by Exposition

The Second International Lighting Exposition, which will be held November 3-7, at Chicago, has announced competition for $1,200 in merit awards.

The competition is to show "What Planned Lighting Can Do" in industrial, store, and office applications and in floodlighting and street lighting. Entries are to cover reports and data on the results of planned lighting installations made during 1946 and 1947. Deadline for entries is August 31.

In addition to awards of merit, there will be three $100 cash prizes in four classifications: Electrical contractors, utility lighting representatives, architects and consulting engineers, and wholesaler's lighting specialists and salesmen.

An official entry blank, along with rules of the competition and helpful suggestions for the preparation of entries, may be secured from the International Lighting Exposition Award, Suite 818, 326 West Madison St., Chicago.

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98% of Farms Served

Electric service is now available to 30,191 farms or nearly 98 percent of all farms in the 6,200-sq. mi. area served by Public Service Co. of Northern Illinois. Since V-J Day over 1,000 miles of rural lines have been added, bringing the total to 7,500 miles. About 600 miles of additional extensions are now under construction.

SUBMARINE POWER STATION—British sailor at the power controls of one of the 26 submarines which have been called back to three naval dockyards, Devonport, Sheerness, and Portsmouth, to act as power plants. It is estimated by officials that the use of submarines will save about 2,000 tons of coal a week

SEC RULINGS

The Securities and Exchange Commission recently issued a series of orders affecting electric utility companies.

VIRGINIA EAST COAST UTILITIES, INC., a subsidiary of East Coast Public Service Co., has been granted permission to issue and sell a promissory note of $200,000 to the Baltimore National Bank. The note, which will be guaranteed by the parent company, will bear interest of 2½ percent per annum and will mature six months after date of issue. Virginia East Coast intends to use $150,000 of the proceeds to retire its present loan from Baltimore National. (Release No. 7152).

AMERICAN POWER & LIGHT CO., a subholding company in the Electric Bond & Share Co.'s system, has been granted an extension of time to June 30 within which it must sever its relationship with Texas Utilities Co., its wholly owned subsidiary holding company. Texas Utilities was formed in 1945 to group the properties of Texas Power & Light Co. and Texas Electric Service Co., subsidiaries of American, and Dallas Power & Light Co., a subsidiary of Electric Power & Light Corp., another Bond & Share subholding company, into a system controlled by Texas Utilities. When the commission issued its order approving the transactions in October, 1945, it did so because American entered into a stipulation and agreement to dispose of Texas Utilities' interests within twelve months. Meantime, however, American and Bond & Share filed a joint plan for the dissolution of American which included a provision for the retirement of all of American's preferred stock. This included an exchange of portfolio securities of American (including the common stock of Texas Utilities) for shares of its outstanding preferred. (Release No. 7158).

NATIONAL POWER & LIGHT CO., LEHIGH VALLEY TRANSIT CO. and PENNSYLVANIA POWER & LIGHT CO., all Electric Bond & Share system, received commission approval of their joint application covering the sale by Lehigh to Pennsylvania Power & Light of the steam electric generating station at Allentown, Pa., and electric substations at Catasauqua, Sellersville and Bethlehem, for $1,500,000 in cash. Proceeds will be deposited with the trustee under the mortgage securing Lehigh's outstanding bonds, to be used for their retirement in accordance with a plan for the rearrangement of the company's capital structure. (Release No. 7169).

MIDDLE WEST CORP. has been granted an extension until March 31, 1947, to dispose of its holdings of common stock of Northern Indiana Public Service Co. Middle West on August 26, 1946, pursuant to the commission's order, acquired 146,923 common shares of Northern Indiana as a liquidating dividend from Midland Realization Co. (Release No. 7167).

LEGION OF MERIT—Walker L. Cisler, right, receives the legion of merit from Col. A. Riani, U.S. Engineers, for his work in helping restore utility service to damaged areas in the European theater. Cisler is now chief engineer of power plants of the Detroit Edison Co.

VEPCO Negotiations First Use of Anti-Strike Law

First operation of Virginia's new anti-utility strike law has begun with the filing of notices by the International Brotherhood of Electrical Workers, A. F. L., that it was opening new contract negotiations with Virginia Electric & Power Co. and Appalachian Electric Power Co.

Under the law a second notice must be given if and when negotiations fail, after which there can be no strike for five weeks. During that period, the governor may make plans for seizure.

The VEPCO contract, covering 1,850 production and maintenance workers expires March 31.

Besides asking for a general wage increase, check-off of union dues and adjustments in vacations, holiday pay, and evening and night differential, the union proposed that VEPCO agree to submit unsettled issues to arbitration without strike or lockout.

VEPCO cited "unsettled" business conditions, last year's 15-cent hourly increase and possible new federal labor legislation as reasons for suggesting that no major changes be made in the contract.

Anti-Closed Shop Law Applies

VEPCO also proposed that the new contract conform to the state's anti-closed shop law, which becomes effective April 30, and would outlaw the current maintenance of membership provision.

Negotiations have also begun on a contract for 180 VEPCO foremen.

M. C. Smith and William E. Wood, VEPCO vice presidents, are negotiating for management.

Meanwhile the Maryland legislature considered legislation to prevent strikes in public utilities. The Senate judicial proceedings committee was expected to report favorably on this measure, which would grant the state public service commission broad powers for arbitrating any dispute over wages or working conditions.

Organized strikes, picketing, and other efforts to impede utility operations would be forbidden. The commission could enter any dispute which might lead to interruption of service at the invitation of either party or upon its own volition. It would have the same authority to summon witnesses and enforce orders during and following arbitration proceedings that it exercises in regulatory functions. In cases of suspension or limitation of utility service, the commission would take over and operate the facilities affected.

MEETINGS

Oklahoma Utilities Association—Annual convention, Tulsa Hotel, Tulsa, Okla., March 20-21. Miss Kate A. Niblack, secretary, Biltmore Hotel, Oklahoma City 2, Okla.

Previously Listed

Pennsylvania Electric Association—Electrical Equipment Committee, Penn-Harris Hotel, Harrisburg, Pa., February 20-21. Transmission and Distribution Committee, Penn-Harris Hotel, Harrisburg, Pa., February 20-21.

American Society for Testing Materials—Spring meeting and committee week, Benjamin Franklin Hotel, Philadelphia, Pa., February 24-28.

National Adequate Wiring Bureau—Annual Adequate Wiring Forum, Hotel Stevens, Chicago, February 27-28.

American Society of Mechanical Engineers—Spring meeting, Mayo Hotel, Tulsa, Okla., March 2-5.

National Electrical Manufacturers Association—Spring meeting, Edgewater Beach Hotel, Chicago, March 3-5.

Canadian Electrical Association—Western conference, Hotel Vancouver, Vancouver, B. C., March 3-5.

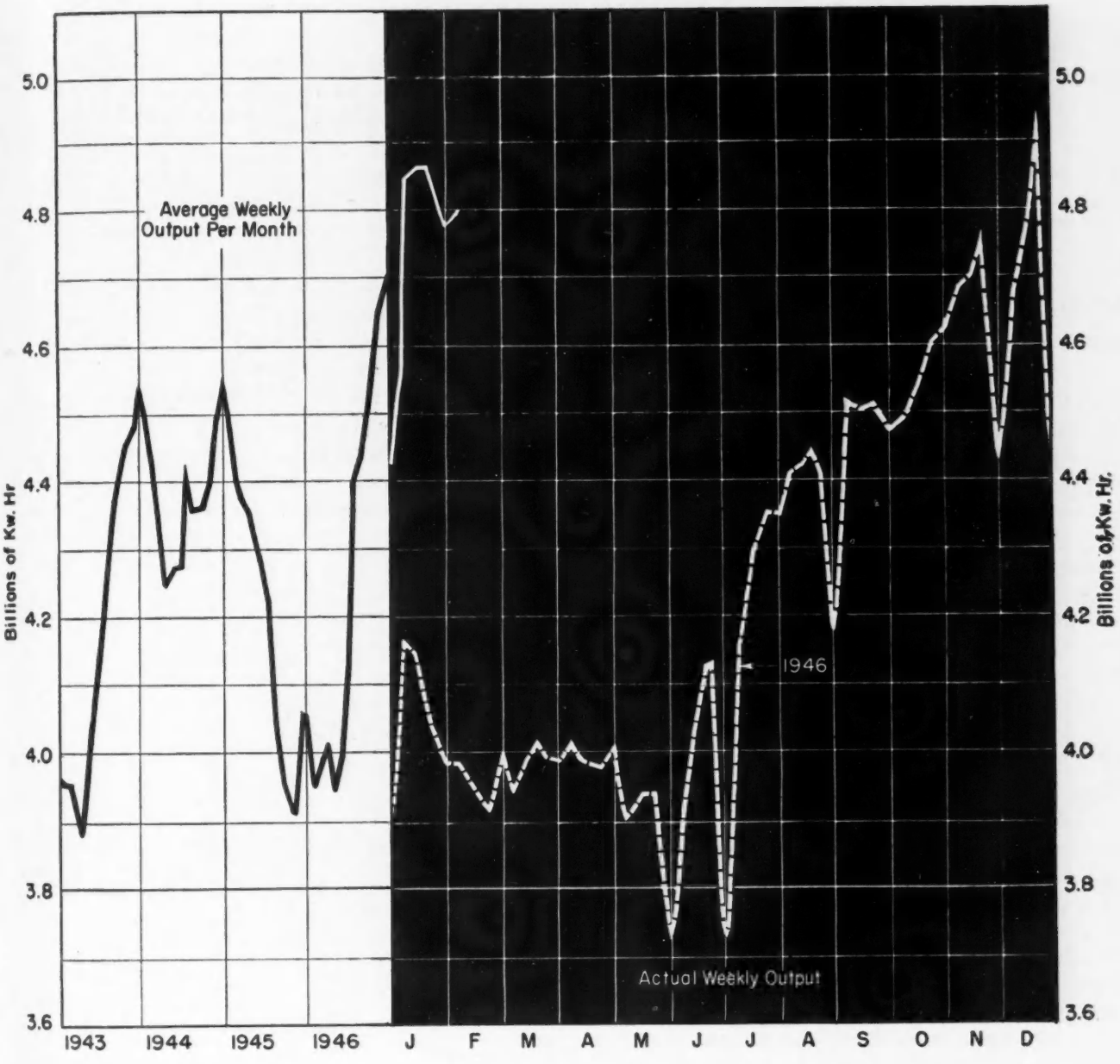
Institute of Radio Engineers—National Convention, Hotel Commodore, New York, March 3-6.

Radio Engineering Show—Grand Central Palace, New York, March 3-6.

Midwest Power Conference—Palmer House, Chicago, March 31-April 2.

Southeastern Electric Exchange—Spring Conference of the Engineering and Operation Section, Sheraton Bon Air Hotel, Augusta, Ga., March 20-21.

Edison Electric Institute—Annual Sales Conference, Edgewater Beach Hotel, Chicago, March 31-April 3.



Operating Revenues Rise 8.5 Percent in November

Electric operating revenues of the larger privately owned electric utilities in the United States in November, 1946, were $285,990,000, as compared to $263,535,000 in November, 1945, an increase of 8.5 percent, according to figures announced by the Federal Power Commission.

Revenue deductions (including operating expenses, depreciation and taxes) were $223,153,000 or 8.9 percent over those of November, 1945.

Gross income, including other utility operating income, amounted to $74,688,000, an increase of 11.0 percent for the month. Net income, after provision for interest on long-term debt and other income deductions, was up 32.2 percent to $55,181,000 compared to $41,740,000 reported for November, 1945.

Output Curve Makes Slight Recovery

The electric output curve turned upward during the week ended February 8, 1947, according to figures released by the Edison Electric Institute.

The amount of electrical energy distributed by the light and power industry during the week amounted to 4,801,179,000 kw.-hr., comparing with 4,777,207,000 kw.-hr. during the preceding week. During the week ended February 9, 1946, the amount of electrical energy distributed totaled 3,983,493,000 kw.-hr., this year's figure representing an increase of 20.5 percent. Last week the increase amounted to 19.9 percent compared with the corresponding week of 1946.

Five of the seven major geographical regions showed larger increases than the preceding week. The most substantial change was reported by the Pacific Coast group, which dropped to a +19.1 percent from a +22.8 percent the preceding week.

Weekly Output, Millions Kw-Hr.

1947		1946		1945	
Feb. 8	4,801	Feb. 9	3,983	Feb. 10	4,505
Feb. 1	4,777	Feb. 2	3,983	Feb. 3	4,539
Jan. 25	4,856	Jan. 26	4,034	Jan. 27	4,577
Jan. 18	4,857	Jan. 19	4,145	Jan. 20	4,588
Jan. 11	4,853	Jan. 12	4,163	Jan. 13	4,614
Jan. 4	4,574	Jan. 5	3,865	Jan. 6	4,427
1946		1945		1944	
Dec. 28	4,442	Dec. 29	3,759	Dec. 30	4,226
Dec. 21	4,940	Dec. 22	4,239	Dec. 23	4,617
Dec. 14	4,778	Dec. 15	4,154	Dec. 16	4,563
Dec. 7	4,673	Dec. 8	4,097	Dec. 9	4,538
Nov. 30	4,448	Dec. 1	4,043	Dec. 2	4,524
Nov. 23	4,765	Nov. 24	3,841	Nov. 25	4,369

Percent Change from Previous Year

	Feb. 8	Feb. 1	Jan. 25
New England	+12.6	+11.1	+13.2
Mid-Atlantic	+12.4	+ 9.4	+10.7
Central Industrial	+30.3	+29.4	+26.7
West Central	+14.7	+13.7	+15.4
Southern States	+22.5	+21.8	+22.4
Rocky Mountain	+ 8.0	+ 9.0	+10.5
Pacific Coast	+19.1	+22.8	+26.2
Total United States	+20.5	+19.9	+20.4

Electrical World
OPINION

In Defense of Decency

AS THIS is written, a number of prominent utility executives who helped shape the war power program stand ready to testify before a Senate Committee as to the character and capabilities of Herbert S. Marks, who has been named general counsel of the Atomic Energy Commission.

Marks, although not up for confirmation, has been attacked by Sen. Kenneth McKellar as a man whose sympathies lie too close to the Communist Party line. The attack, of course, is an extension of McKellar's long-standing feud with David E. Lilienthal, who negotiated Mark's appointment.

Those utility men who stand ready to testify are men who know Marks from the war days, when he was counsel and, for a time, director of the Office of War Utilities and its predecessor organizations. They know first-hand the affirmative contributions to the war power program which Marks made. They know that, despite his public ownership background, Marks was a leader in the fight to prevent the war power program from being controlled by partisans of either public or private ownership.

ELECTRICAL WORLD, which covered the war power program from start to finish, knows these facts as well. Its printed pages from mid-1941 through 1945 testify to the excellence and justice with which the program was carried out. ELECTRICAL WORLD joins those industry leaders who stand ready to testify on Marks' behalf.

The Engineering Exhibit

FOR THE FIRST TIME those who attended the winter meeting of the American Institute of Electrical Engineers have had an opportunity to see an exhibit of new products. It was a venture independent of, but sanctioned by, the Institute and, judging by the patronage and the attendance, it achieved as much success as should be expected for a first attempt. Certainly it should be rated far from dubious when it is known that attendance was practically 8,000 and that some two-thirds of the 3,500 registered at the technical sessions went a few blocks away to view the displays. The 5,500 others came from contracting, construction and consulting groups, attendance of the general public having been discouraged.

Meetings of other engineering societies are regularly paralleled by similar showings of the materiel of their arts and there seems to be no sound reason, in principle at least, why the electrical engineers should not be granted a comparable privilege. It could well become a fixture for the winter meeting whether it be held in New York or elsewhere. Such an arrangement would provide a means for visual inspection of the advances that might otherwise have to claim a large part of the paper program and technical discussions at the week of Institute sessions. As a consequence the sessions could appropriately be devoted to a broadened array of informal conferences aimed at surveying the state of the art in the many branches embraced within the Institute. The members attended this year's conference sessions in large numbers and seemed to welcome what they heard.

Just at present the lag of production behind demand removes one of the potent incentives for manufacturers to exhibit—the desire to stimulate interest and create demand. Circumstances may well be more favorable a year hence and the current excuse may be lacking. Some who refrained from participating in the 1947 exposition are said already to have indicated the intention to have entries at the 1948 show scheduled for the Pittsburgh winter meeting. If more do so it will help assure the revival of engineering displays that years ago were a regular accompaniment of conventions of the industry, none, however, so exclusively and intensively engineering as are those of the A.I.E.E.

Safety Engineering Needs Better Records

MANPOWER SHORTAGES handicapped utility engineering departments during the war. Consequently, much important work in method standardization had to be set aside to permit supplying of industrial loads. Considerable safety work was performed without suitable permanent records of specific techniques. Results have been surprisingly good in view of the obstacles; but it would seem that with the expansion of engineering and drafting department personnel now in process in so many companies, the time has come again to stimulate such work and to insure that none of it be lost.

Loose-leaf systems now in use are adaptable to other applications. Suggestions and awards for exceptionally good ideas are developing rapidly, many of which focus on accident prevention. Bulletins, letters, cartoons and case studies of dangerous practices are multiplying in many companies. Insurance groups are contributing and spreading information on safety work. The field for interchanging such information between utilities is broadening, but there are still too many instances of a lack of concentrated information, well illustrated and indexed, accessibly filed and systematically preserved. If this problem be attacked from the record-making standpoint, further gains surely can be realized, both in circulation of valuable material and ideas, and in retaining previous gains.

Line Material Salvage Is Good Economy

RECLAIMING material and rebuilding equipment was a practical necessity during the years of shortages, and many companies made shop-salvage arrangements where none existed before. As the shortages are relieved continuance of salvage will be reexamined.

As has been proven by many companies through prewar experience, a salvage and repair program is a good long-term policy. During the emergency, there were undoubtedly many cases of patching, of "make it do." Normally, salvage means spending an average of 25 percent of new value to return an item to new stock.

Repairs for salvage should be on the basis of returning the reconditioned material to stock bins with new material. Testing and inspection for acceptance in stock should follow the same specifications used for purchases. Substandard material has no place in this salvage.

Replacing rusted parts of pole racks, regalvanizing braces and other hardware, installing new switch contacts, cleaning insulators, and rebuilding larger pieces of equipment call for expert mechanical supervision. Knowing what to scrap and where to draw the line on spending money for repair requires a good sense of economy. Thus qualified, a salvage operation is a good investment and should not itself be scrapped.

Freeway Relocation—An Imposition

WITH multi-million dollar highway programs involving many freeways in every state of the Union, utilities are faced with heavy relocation costs. They have almost invariably been the goat in the past. It did them little good to protest. However, the high costs of relocating for freeways is "the straw that broke the camel's back."

Cases are coming up right along where it will cost one utility up to $50,000 to relocate for a single small section of freeway. Multiply the expense which local rate payers of utilities must stand for moving water, gas, telephone and electric facilities, and the burden is unjust, disproportionate and inequitable, to say the least. It is particularly hard and unfair to the smaller utilities serving only limited areas. One freeway job could bankrupt some of these.

Utilities, in presenting their case before highway commissions, reason that it is manifestly unfair to penalize local rate payers for statewide and nationwide improvements. They argue too, that at least their pro rate of gasoline tax funds should be applied against this cost of relocating utilities. To expect utilities to stand relocation cost is about as reasonable, they say, as to ask abutting property owners to pay the cost of grading for a freeway.

State highway commissions will hang moving costs onto the utilities as long as they can get away with it because it makes their funds go just that much further. But, after all, there is reason to all things, and utilities, both private and municipal, have joined in some states and are demanding a new deal. It is high time—they are entitled to it.

WASHINGTON COMMENT

By R. N. LARKIN

ONE YEAR AGO, Harold Ickes, then Secretary of the Interior, restated that department's power construction and marketing policy. Julius A. Krug's accession raised considerable speculation as to the continued applicability of the Ickes policy.

After eleven months of Krug's regime, it is pretty apparent that all but one of the most imposing points of the Ickes policy remain in effect. Regarding Ickes' less spectacular points, the presumption must be that they, too, remain in effect.

The one casualty from the Ickes program seems to be that directing "Active assistance, from the very beginning . . . shall be given to the organization of public agencies and cooperatives . . . The statutory objectives are not attained by merely waiting for a preferred customer . . ."

This point, most spectacular of all, seems to have died, in Krug's instruction to Interior's regional people to cease electioneering and public talks in favor of publicly owned distributing agencies.

Icke's other two outstanding points are in the best of standing, if Interior's latest annual report be correct.

Ickes had directed that hydro plants be installed wherever feasible, each having "its own steam standby and reserve facilities where necessary to independent operation . . ." Regarding transmission lines, the Ickes policy demanded "adequate" transmission which "must be owned by and controlled by the government unless privately owned facilities should be made available upon terms which assure full accomplishment of the basic objectives of the congressional power policy . . ."

Interior's latest report reiterates that government-owned steam capacity and transmission lines remain prime objectives of departmental power policy.

In one regard, the latest Interior report goes beyond Ickes' policy. This is in connection with the planning of power installations at Army Engineer hydro plants, whose output Interior markets. The Engineers plan their own water projects, while the Federal Power Commission studies power markets and recommends capacity installations for them.

Interior now, as marketer of such power, wants to participate in the preliminary studies, the choice as between projects, determination of size and character of the facilities, timing of their submission to Congress, allocation of costs, determination of their accounting, and determination of the timing of additional units. Also, it wants responsibility for power operation of Army dams.

All these things make it plain that Interior's power planners have not been sufficiently impressed by the November revolution in federal government to change the tune they sing publicly. For them, the theme remains one of more and better public ownership.

Coals to Newcastle . . . ?

SPA POWER GRID *Carries* Hydro Output *to* Gas Fields

Five-state Southwestern Power Administration transmission net moves hydroelectric energy from Army dams into low fuel-cost area and away from higher fuel-cost area . . . Kansas City and St. Louis load centers ignored by Interior Department marketing agency

ACCORDING to the descriptions of the Southwestern Power Administration which its proponents laid before Congress a year ago, the agency is to be, among other things, a source of abundant cheap power for the area its proposed $200,000,000 transmission and steam-electric grid is designed to serve.

Study of data presented by SPA in its "Comprehensive Report" and of other data compiled by the Federal Power Commission and the Rural Electrification Administration raises the question as to whether SPA is not concentrating on the wrong states. (SPA's transmission grid, as outlined in its "Comprehensive Report," would serve all or parts of Arkansas, Oklahoma, Texas, Louisiana and a small portion of Missouri.)

Misses Replacement Chances

The belief that SPA's grid does serve the wrong territory arises from the presumption that good power system economics would dedicate new sources of low-cost energy to the replacement of existing sources of higher-cost energy, assuming of course that such replacement is physically possible. This, according to SPA's map of its proposed system, and supported by data from SPA itself and other federal sources, is not the plan under SPA's program.

The area of controversy is shown on the accompanying map.

Locating the center of SPA's system at that hydroelectric station nearest the center of its heaviest transmission lines makes Bull Shoals Dam, in north central Arkansas, the center of SPA's primary market potential. Just to designate Bull Shoals as the center of SPA's territory may be considered arbitrary. This dam, however, does lie about midway on the heaviest portion of SPA's proposed grid.

Whether Bull Shoals be the proper center point, 23 of the 29 authorized and proposed hydroelectric stations (two have been built) which the proposed SPA system would integrate are concentrated in the northern half of the area SPA proposes to serve. Their output could flow north as well as south.

As may be seen from the map, SPA's proposed transmission system extends south from Bull Shoals, not north.

High-Cost-Low-Cost Area

Generally speaking, the cost of fuel for power generation is decidedly cheaper to the south and southwest of an arc, shown on the map, which extends from Pascagoula, Miss., northwestward to Helena, Ark., Ozark Beach, Mo., Hutchinson, Kan., thence southwestward to the Oklahoma Panhandle near Boise City, than it is to the north and northeast of this arc. Yet the area proposed by SPA to be served by its grid lies almost completely within this arc. A small section of SPA's proposed system extends northeastward into the area of higher fuel costs, and some areas not served by SPA lie within the area of lower fuel cost.

It is the interrelationship between this disparity in fuel costs and the proposed location of SPA's transmission net which indicates that SPA would serve the wrong area.

Study of FPC data on fuel costs

TABLE I—Low Fuel Cost Group

No.	System	Total fuel cost for steam generation, 1945	Total steam generation, 1945 (kw.-hr.)	Fuel cost per kw.-hr. of steam generation in mills. 1945	1944	On SPA Grid Yes	No	Percent of system energy
1.	Arkansas P. & L.	$629,393	405,988,000	1.55	1.58	x		31.6
2.	Dallas P. & L.	1,062,651	599,024,000	1.77	1.72	x		96.5
3.	Houston L. & P.	1,871,815	1,503,594,000	1.24	1.27		x	82.7
4.	Gulf States Utils.	1,511,762	1,331,575,000	1.13	1.18	x		85.7
5.	Oklahoma G. & E.	1,728,657	1,016,978,000	1.69	1.67	x		91
6.	Pub. Ser. Co. of Okla.	915,762	645,283,000	1.41	1.47	x		73.7
7.	Southwestern G. & E.	442,205	402,940,000	1.09	1.15	x		58.9
8.	Texas P. & L.	663,986	894,785,000	0.74	0.84	x		66.4
9.	Empire Dist. Elec.	851,103	348,496,000	2.44	2.70	x		78.2
10.	Mississippi P. & L.	26,053	2,275,000	11.4	9.32		x	0.5
11.	Mississippi Power Co.	298,106	143,996,000	2.07	4.79		x	36.8
12.	Kansas G. & E.	946,337	618,568,000	1.52	1.55	x		95.9
13.	Louisiana P. & L.	860,486	966,422,000	0.88	0.92	x		78
Total		11,808,317	8,879,924,000	1.32	1.37			
Adjusted Total*		11,782,264	8,877,649,000	1.32	1.36			

** Adjusted to omit Mississippi P. & L. whose steam generation is only 0.5% of its system energy.*
Source: Fed. Pow. Com.

of 20 privately owned systems within 300 miles of Bull Shoals dam or within the SPA area reveals that 13 of them are within the low-fuel-cost area, while seven are in the higher-fuel-cost area. Of the 13 companies in the low-cost area, ten are touched or directly affected by SPA's proposed grid. Of the three not on the grid, two are in Mississippi, into which SPA is not authorized to extend, and the other is just beyond SPA's proposed system. Of the other seven, in the higher-cost area, only one is on SPA's grid.

That fuel costs of the 13 companies in the low-cost areas are definitely lower than those per kilowatt-hour in the higher-cost area is demonstrated by Table I, which shows an average cost of 1.32 mills per kilowatt-hour in the low-cost area, where gas predominates as fuel. In the higher-cost group, the average fuel cost per kilowatt-hour is 2.49 mills, (Table II). If adjusted to omit the Union Electric Co. of Missouri, whose steam generation was only 8.8 percent of its system energy in 1945, the average fuel cost per kilowatt-hour is 2.35 mills, (Table II).

Interestingly, in the low-cost area, ten of the 13 companies had lower fuel costs per kilowatt-hour in 1945 than in 1944, whereas in the higher-cost area, where coal predominates as fuel for steam generation, only two of seven companies had lower fuel costs per kilowatt-hour of steam generation in 1945 than in 1944, while the other five reported fractionally higher fuel costs.

Omitting Mississippi Power and Light, where the company's steam generation in 1945 was only 0.5 percent of system energy, and Union Electric of Missouri, where it was only 8.8 percent, only two companies in the higher-cost area show 1945 fuel costs per kilowatt-hour any lower than the rate of the highest-cost company

SPA'S PROPOSED TRANSMISSION SYSTEM would carry the output of hydro projects south to the gas fields where steam-electric power generation is cheapest. Arc extending from southeast to northwest shows approximate division between high fuel-cost and low fuel-cost areas, the latter to the south of the arc

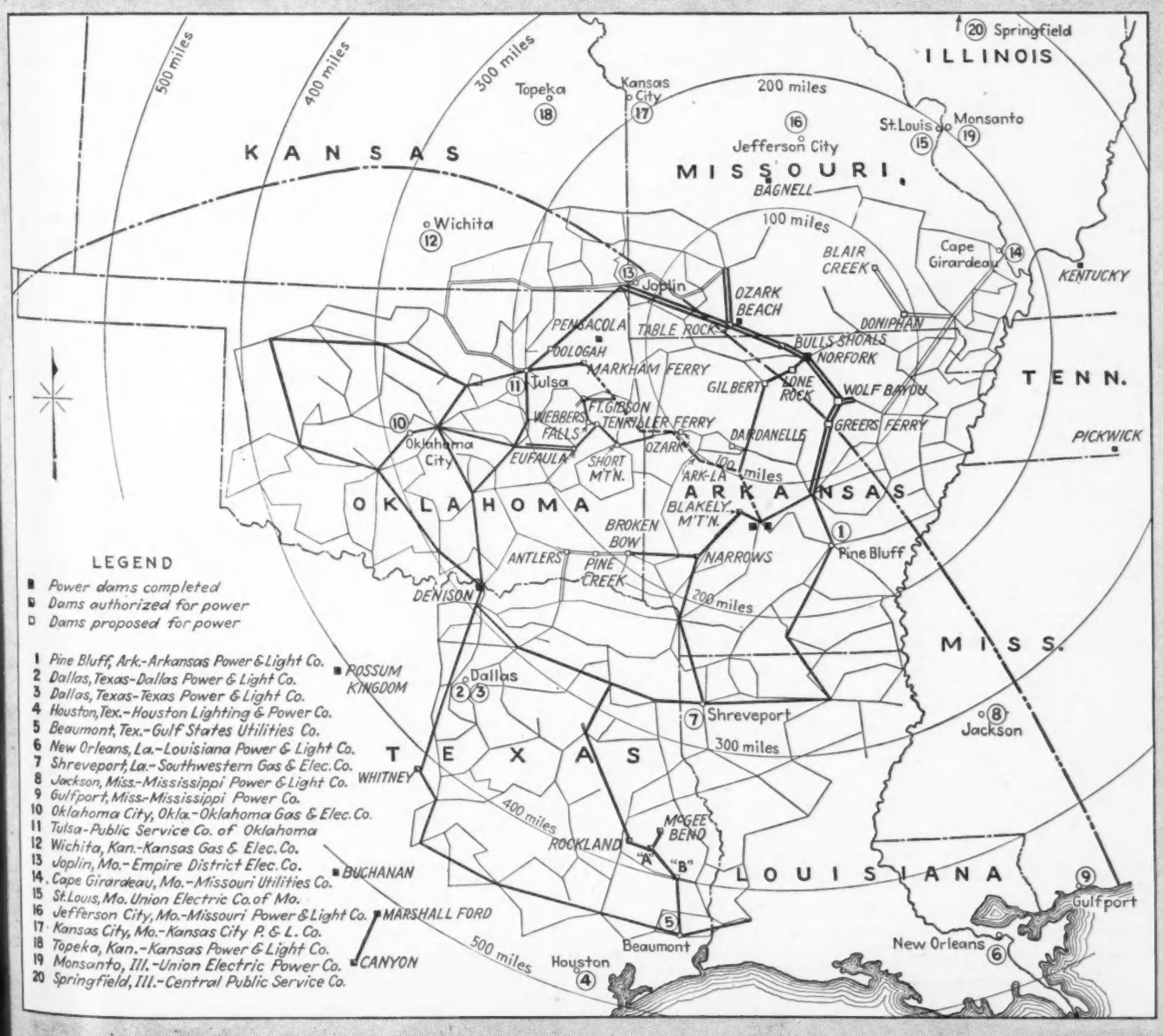


TABLE II—High Fuel Cost Group

No.	System	Total fuel cost for steam generation in 1945	Total steam generation, 1945 (kw.-hr.)	Fuel cost per kw.-hr. of steam generation in mills. 1945	1944	On SPA Grid Yes	No	Percent of system energy
1.	Kansas City P. & L...	3,578,406	1,329,883,000	2.69	2.65		x	99.3
2.	Kansas Power & Light.	1,239,593	451,917,000	2.74	2.80		x	95
3.	Union Elec. of Mo... ..	1,243,660	218,645,000	5.68	8.34		x	8.8
4.	Union Elec. Pow. Co....	5,164,595	2,562,555,000	2.01	1.92		x	82.4
5.	Missouri P. & L.....	536,115	140,775,000	3.80	3.72		x	79.1
6.	Missouri Utilities.....	188,316	58,611,000	3.21	3.18	x		82.1
7.	Central Illinois P. S. Co..	1,381,916	580,499,000	2.38	2.24		x	63.7
Total.....		13,332,601	5,342,885,000	2.49	2.34			
Adjusted Total*.....		12,088,941	5,124,240,000	2.35	2.27			

** Adjusted to omit Union Electric Co. of Missouri whose steam generation is only 8.8% of system energy.*
Source: Fed. Pow. Com.

in the low-cost area. The difference between the lowest-cost per kilowatt-hour in the low-cost group and the highest in the high-cost group, again omitting Union Electric of Missouri, was slightly more than 3 mills per kilowatt-hour.

These figures, compiled from FPC data, indicate clearly that SPA energy would move into the area of definitely lower fuel costs, away from an equally accessible area in which fuel costs are substantially higher.

Some of the most enthusiastic support for SPA as it appeared before Congress early last year asking the first appropriations for its system came from REA cooperative leaders. Twelve of them, ten of whom represented individual cooperatives, and two of whom represented groups of cooperatives, hailed SPA's proposal as a magnificent thing for rural electrification. Again, however, it appears that SPA is aiming to serve the wrong cooperatives.

Co-op Energy Costs Suffer

Figures compiled by REA, (Table III) for the twelve months ending last June 30, show that in four states in which SPA's grid is to extend, average cost per kilowatt-hour of energy purchased by the co-ops is 7.17 mills, while in four states within transmission distance of Bull Shoals in which SPA does not plan to render service, average cost to co-ops for purchased energy is 9.25 mills. SPA actually does plan to render limited service in Missouri, one of the four states listed in the group as not served by SPA. Its service there, however, is projected in SPA's "Comprehensive Report" to consist only of 16 connections to twelve of Missouri's 43 co-ops in existence December 31, 1944.

Of the ten witnesses who appeared representing cooperatives, nine represented co-ops in SPA territory. The other representing a co-op beyond SPA's system in Missouri was an officer of another co-op which would be served by SPA. Of the five who signified what rates they paid for energy in 1945, four, who bought energy from Arkansas or Oklahoma companies, testified to wholesale rates of 6-, 6.1- and 7 mills. The fifth testified that his co-op paid 10.5 mills, to an Oklahoma municipal system. Four of these rates are below the low-cost area average.

As of December 31, 1944, there were 34 more cooperatives in the SPA territory, not including Missouri, than there were in the other four states considered here, including Missouri. At that time, however, the connected membership of the co-ops in servable territory not to be served by SPA was greater than that of the co-ops in SPA territory. This small difference doubtless would disappear if allowance were made for the co-ops in Missouri which SPA plans to serve, but would not alter the fact that SPA, in building its system south from Bull Shoals, is turning its back on as many farmers as it approaches. In the matter of total state populations, the four states to be served by SPA have a population smaller than the four which would not be served, again considering Missouri as a state not served by SPA.

Just why SPA sends its energy into the low-fuel-cost area to the exclusion of an equally accessible higher-cost area is known only to SPA and Interior Department officials who devised the system.

Saving Room for MVA?

One inescapable conclusion, however, is that the area to the north of SPA's system is being reserved for importations of energy from the Missouri River generating plants authorized for construction by the Army Engineer Corps and Interior's Reclamation Bureau. Several of these have already been started, and others are authorized, awaiting only the resumption of full-scale federal construction. Still others are authorized but not yet appropriated for.

Such a decision is entirely within the purview of the Interior Department, under Section 5 of the Flood Control Act of 1944.

TABLE III—Energy Purchased by REA-Financed Systems by States, from All Supplies, Privately and Publicly Owned, Fiscal Year Ended June 30, 1945

NO.	STATE	SUPPLIERS	KILOWATT-HOURS PURCHASED	COST OF ENERGY	COST PER KW.-HR. IN MILLS	ON SPA GRID YES	NO
1.	Arkansas	Private	23,788,737	$182,805	7.7	x	
		Public					
		All	23,788,737	182,805	7.7		
2.	Louisiana	Private	17,162,242	180,441	10.5	x	
		Public	361,219,930	1,472,422	4.1*		
		All	378,382,172	1,652,863	4.4		
3.	Oklahoma	Private	24,175,660	212,505	8.8	x	
		Public	12,714,828	106,411	8.4		
		All	36,890,488	318,916	8.6		
4.	Texas	Private	65,927,890	525,360	8.0	x	
		Public	53,240,263	399,696	7.5		
		All	119,168,153	925,056	7.8		
5.	Kansas	Private	15,362,874	151,900	9.9		x
		Public	15,644,097	171,404	11.0		
		All	31,006,971	323,304	10.4		
6.	Mississippi	Private	35,992,760	269,757	7.5		x
		Public	54,006,327	345,875	6.4		
		All	89,999,087	615,632	6.8		
7.	Missouri	Private	85,819,820	785,379	9.2		x**
		Public	22,767,642	262,239	11.5		
		All	108,587,462	1,047,618	9.6		
8.	Illinois	Private	73,683,465	743,813	10.1		x
		Public	8,977,900	96,924	10.8		
		All	82,661,365	840,737	10.2		

** Sales by Ark-La Electric Co-op to Lake Catherine aluminum plant.*
*** Makes 16 connections with twelve of Missouri's 43 co-ops.*
Source: REA

Distribution System Economics For Light Load Density Areas...II

Premature building or rebuilding of feeders can be averted by use of regulators and capacitors to hold up the voltage as loads double or triple

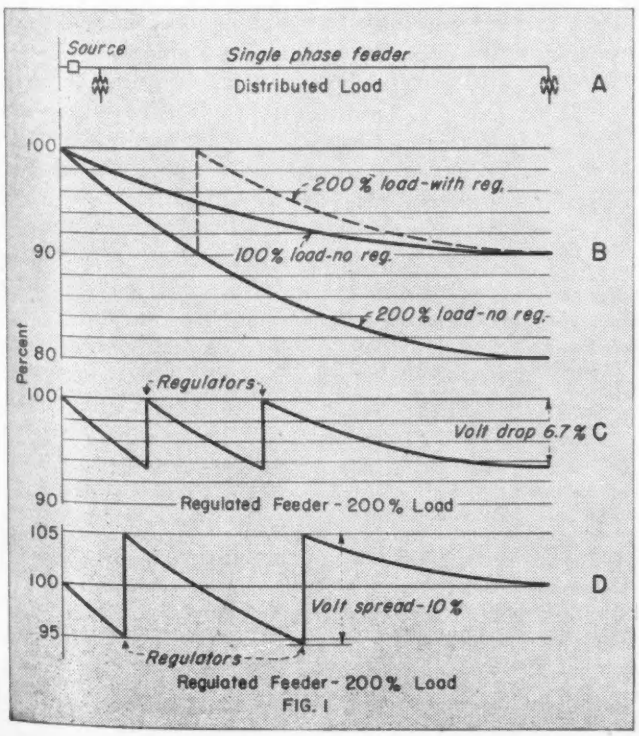
O. B. FALLS, JR., *Power Distribution Division, General Electric Co.*

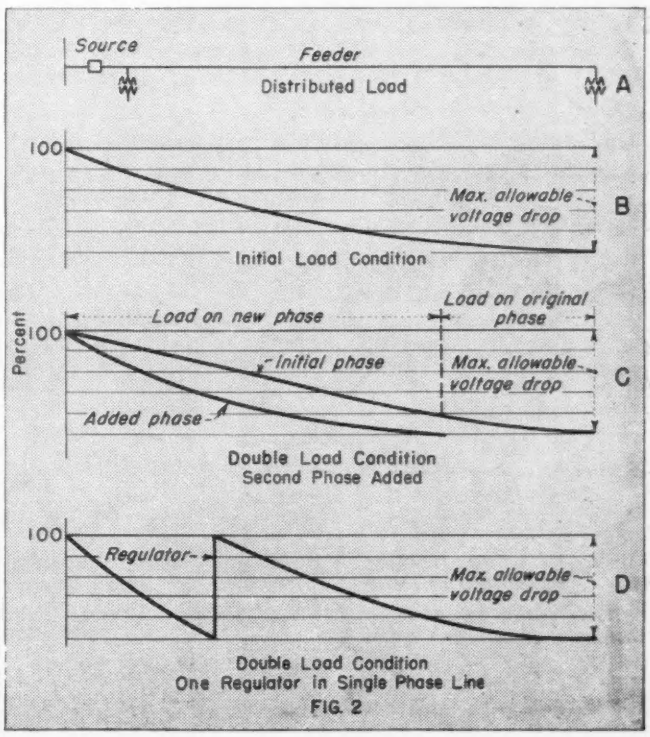
AREAS of light load density can be served appropriately and economically with primary lines of higher voltage. This was demonstrated in the preceding instalment. Where the justification does not exist for such changeover the feasible alternatives are generally, (1) to add phase wires for all or part of the distance, (2) apply regulators, (3) apply capacitors, or (4) both regulators and capacitors. In what follows the purpose will be to show the merits in using either or both capacitors and regulators in amplifying the load-carrying ability of existing circuits.

Using regulators at the substations or in the lines may result in delaying or eliminating the rebuilding of an existing feeder or adding new feeders.

Fig. 1-A shows a simple radial feeder carrying distributed load along its length. It might be either single or three phase, at any voltage. It is loaded initially so that a voltage drop of 10 percent is obtained at the end, as shown in B. Ten percent spread in primary voltage between first and last transformer is probably excessive but may not be considered too much so for rural or light density distribution. However, it should not be allowed to exceed this value since it must be remembered that the spread in *customer* voltage will be the primary drop between first and last transformer plus the drop in the distribution transformers and secondary circuits which may add from 5 to 7

FIG. 1—Regulators restore voltage performance to same drops and spreads as held before . . . FIG. 2—Regulator on single phase may prove less expensive than extension of second or third phase to share the load and the voltage drop





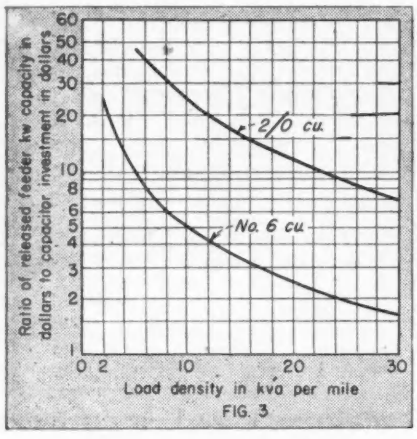


FIG. 3—Dollar value of feeder capacity released by capacitors, 7.2-kv., single-phase line with load (0.9 p.f.) uniformly distributed; assumed voltage drop 10 percent; capacitor cost, $7 per kva.; line cost (2/0), $1,570 per mile, (No. 6), $950 per mile

percent more drop for the circuit.

If the load increases, the primary drop will increase and one way to correct for this is to use regulators in the line between the first and last transformer. The use of regulators in this manner is illustrated in Fig. 1-B, -C and -D. If the load is doubled, the primary drop becomes 20 percent, which we will say is excessive. If one regulator with 10 percent boost range is installed, the voltage conditions can be brought back to the original spread. This is shown in B. Two regulators could be used, however, to obtain somewhat better conditions. If installed as in C the primary voltage spread is reduced to about 6.7 percent but all variation is below normal and each regulator is boosting only about 6.7 percent. If these were regulators having 10 percent boost range, they could be installed as shown in D, producing a higher average voltage along the line, but the spread is now 10 percent, or the same as shown in B with one regulator.

If regulators are not used, there are several other alternative means of correction. If the line is three phase either a new feeder could be erected or larger copper installed. If the line is single phase one alternative would be to add the second, and possibly, the third phase. This can be costly, however, as compared to the use of regulators. Fig. 2 illustrates some comparative conditions.

Again A indicates a simple radial feeder, in this case considered as single phase. B shows the voltage condition with initial or 100 percent load. If the load doubles and the second phase is added and all load along its length transferred to it, the second phase must be about 70 percent of the length of the original phase in order to limit the voltage drop on either phase to the original value shown in B. A regulator could be added to the original single-phase line, however, as shown in D, and the same general result obtained.

The comparative costs are shown by the following specific example: Single-phase line, 7.2 kv., No. 6 copper, 25 miles long. Load—initial—125 kw. at 0.9 p.f.; future—250 kw. Voltage drop 10 percent. *10 percent drop must not be exceeded.*

If line conductors of larger size were installed, this would mean using at least No. 2 copper amounting to 33,000 lb. more than if No. 6 were used which, at 15 cents per pound, is about $5,000. This does not include the labor cost of taking down the old and installing the larger conductors nor does it take into account any change in the cost of poles due to any difference in span lengths.

Polyphase More Expensive

If another phase or the same size conductor were added it would require about 17.5 miles of line to be added which would cost in the order of $8,000 installed. A 7.2-kv., 50-amp. regulator, having four 2½ percent steps, would accomplish the same result from a voltage standpoint and cost less than $1,400 installed.

It should be pointed out that there are at least two factors which may affect any final conclusions for specific cases. First, if energy is purchased, the higher losses occasioned by carrying the heavier loads on smaller conductors might be enough to warrant serious consideration being given to them in this type of evaluation. Second, where single phase is involved, the addition of the second phase may be advisable or necessary to obtain better load balance on the substation.

Regardless of these offsetting factors, however, these comparisons indicate that there is a definite place for the regulator in the design of light density lines.

Shunt capacitors can be logically applied to light density circuits. In fact, the return on investment in capacitors for most light density lines is in general much greater than on urban feeders even though a kva. of capacitor does not release as many kilowatts of load capacity on a rural as on an urban feeder. Their economic justification is based on the fact that the kilowatts released on rural lines are worth considerably more in dollars. A kilowatt of line capacity on a rural line can easily cost from 10 to 15 times that on an urban feeder.

If a rural line is not loaded, capacitors cannot be justified except on the basis of benefits derived elsewhere in the system. As the line becomes loaded, however, the capacitor lends itself particularly well to obtain the maximum line capacity at minimum cost. This is especially true of the longer lines having light load density and is becoming more important at present because of the expected increases in load on some long light density circuits.

Increase in kilowatt-carrying capacity of the feeders is due primarily to the reduction in full-load voltage drop resulting from the application of shunt capacitors. The increase in kilowatt-carrying capacity is directly proportional to the voltage rise effected by the capacitors.

Good Return from Capacitors

Fig. 3 shows the comparative return on light density feeders due to the application of capacitors.

In preparing this chart, the line was assumed to be single phase, 7,200 volts having a uniformly distributed load of approximately 0.9 p.f. Load densities from 2 to 30 kva. per mile were included and it was assumed that the maximum allowable voltage drop would be 10 percent. Two sizes of conductor, No. 6 and 2/0, were considered. These probably represent the extremes for most cases.

For these conditions, the value of the released kilowatt capacity and the installed cost of the capacitors required to release this amount of kilowatt capacity was determined. The ratio of these two gives a measure of the return to be expected through the use of the capacitors. It can be seen from this chart that a better return is obtained on the larger conductors and the lower load densities, although

the return for the small wire sizes and the higher load densities is by no means insignificant. Although this chart is based on 7,200 volts only, the return to be expected for other voltages ranging from 4 kv. up to 13.2 kv. will be of the same order with corresponding wire sizes.

Place on Light Density

Thus, from this chart, it can be seen that there is definitely a place in distribution system design for the application of shunt capacitors on light density circuits. The return when considering only released feeder capacity should be sufficient to justify the use of shunt capacitors in many cases, and if reduction in energy losses and release of substation capacity is also evaluated, there will be many more cases where the shunt capacitor can be not only justified but used to reduce system cost.

When studying the application of shunt capacitors to feeder circuits, cases will be found where it would be desirable for various reasons to add more capacitors to the line than could be allowed due to excess voltage rise at the end of the line under light load conditions. This brings up another point which has not been properly evaluated in many instances. This is that although certain very definite benefits can be obtained through the *separate* application of shunt capacitors or regulators, the use of regulators and capacitors *in combination* is a "natural." In other words, the simultaneous use of both of these types of equipment on a given circuit allows the maximum benefit to be obtained from each. (See Fig. 4)

This chart (Fig. 4) shows, at the top, a simple radial feeder which might be either single or three phase carrying uniformly distributed load. At the end of this line is installed a bank of capacitors.

Capacitors, Regulators, Both

For purposes of illustration it has been assumed that this feeder is loaded so that it has a primary voltage drop of approximately 20 percent, from the source to the end of the feeder. This value might seem to be excessive; however, it could well represent many present-day circuits serving light load density areas if the load on the circuit should increase appreciably. The voltage profile along the circuit under full-load conditions with no capacitors connected to the circuit is shown in the lower curve of Fig. 4A. If the capacitors are of sufficient size to produce a voltage rise at light load of 5 percent as shown by the dotted line, the voltage at the end of the circuit under full-load conditions is still too low to be considered adequate. If capacitors only are to be used, more capacitors might be added at the end of the line. For example, as in Fig. 4-B, enough capacitors are added at the end of the line to produce a voltage rise of 10 percent under light load conditions resulting in approximately 10 percent maximum drop along the feeder under full-load conditions. This full load condition might be considered tolerable. However, the light load condition produces a voltage at the end of the circuit which is entirely too high, 105 percent being considered an average maximum value.

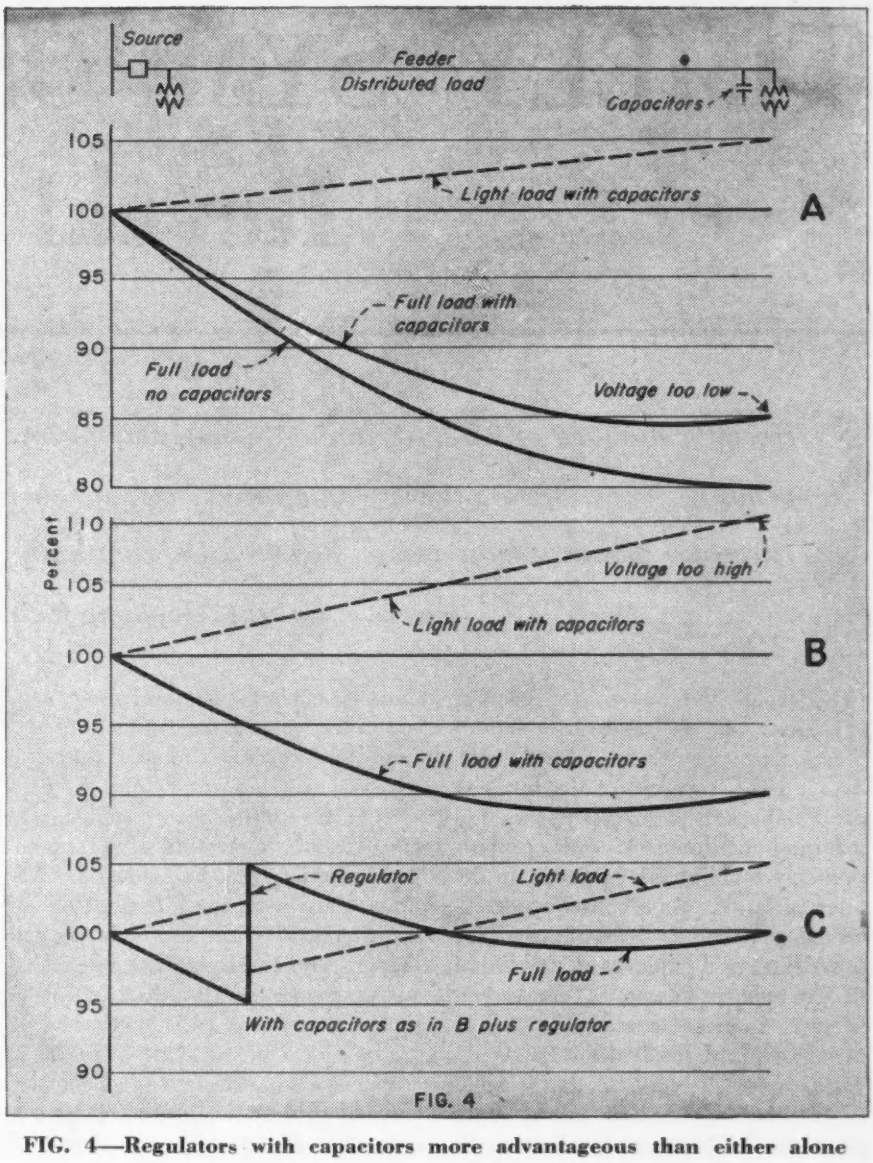


FIG. 4—Regulators with capacitors more advantageous than either alone

It would still be possible, however, to connect this many capacitors to the feeder and obtain reasonable voltage conditions by adding a regulator as shown in Fig. 4-C. Here the regulator is giving full 10 percent boost under full load conditions and producing very good voltage levels all along the line. Under light load conditions, it will buck the voltage down approximately 5 percent allowing only a 5 percent overvoltage on those customers near the end of the line. Thus, the addition of a regulator to this line has allowed the full complement of capacitors to be added, with the resulting benefits, and allowing considerably better average voltage conditions to be obtained all along the line than if either the capacitors or regulators had been used separately.

TIMELY SYMPOSIA Reveal Resumed

Heavily attended A.I.E.E. Winter Meeting emphasizes open forum discussion of pending issues. Among them—untapped sources of energy, interconnection administration, power for welding, distribution continuity, industrial controls, light sources and rural telephone facilities

TONE of the papers and discussions at the A.I.E.E. Winter Meeting in New York, January 27-31, 1947, reverted to the familiar pre-war pattern of formal papers and informal conferences with proportionately more stress, however, in the later instance. As a consequence excellent opportunity was afforded for broadened and exploratory treatment of current problems of more embracive interest across the whole membership of the Institute.

Examples included in the selected discussions digested in the ensuing pages are the exploration of relatively unused (perhaps unattainable) means of electric energy generation still confined to the magnitudes of the electrophysicists' laboratory and the canvass of the approaches by which more effective administration of system interconnections can be achieved. Another pair comprised the matter of improving reliability of distribution systems and the somewhat related issue of accommodating distribution to the exigencies of resistance welding loads.

Significant progress and success was reported for the several collaborative methods recently instituted to get telephone service to rural citizens, over or independently of the lines extended to deliver power service.

One notable feature was the decreased number of papers devoted primarily to the claimed advantages of new products. Another was the indication that radar pulses—far off in the frequency spectrum—have potentialities for industrial control and for locating faults on power circuits.

Attendance was over 3,500, a number well over 800 in excess of the previous (1946) amount of 2,600.

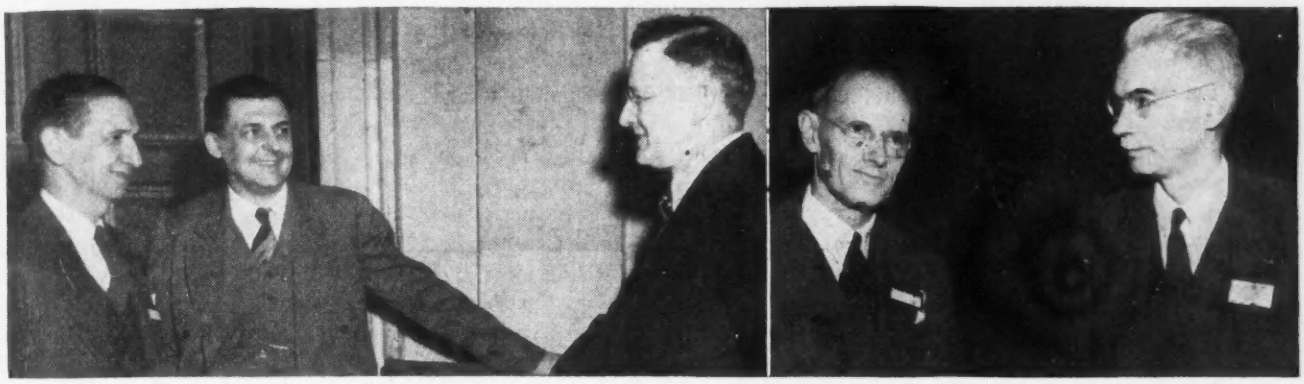
C. S. Purnell, chairman A.I.E.E. Winter Convention Committee, and C. T. Hatcher, chairman, Smoker Committee

Energy Sources

Small likelihood exists that the commonly used method of electricity generation by electromagnetic means will ever be seriously challenged by energy production employing electron emission or piezoelectric phenomena. But electrostatics is quite another story and it may be that experimentation and research now in progress will bring onto the stage ways of electricity generation and utilization different from those now in use.

Opening the conference, L. W. Matsch, Armour Research Foundation, listed eleven different ways of electricity production — electromagnetic, thermoelectric, electrostatic, thermomagnetic, electrochemical, piezoelectric, contact, emission, pyroelectric, magnetrostrictive, and earth potential. Three of these classes of phenomena—emission, piezoelectric, and electrostatic—were the subjects

Technical Developments



L. L. Crump, J. R. Kearney Corp.; J. H. Miller, Weston Electrical Instrument Co.; J. O. Leslie, Gilbert Associates; W. C. Downing, Jr., Sangamo Electric Co.; and G. C. Waite, Sangamo Co. Ltd.

of papers presented at the conference.

There are five kinds of emission phenomena, said L. A. DuBridge, California Institute of Technology. They are thermionic, photoelectric, impingement, positive ion bombardment, and field emission. Of these only the first two are of present importance and on them has been built up the vast structure of the electronic arts and sciences of today. There seems to be no prospect of production by emission phenomena of electrical energy in terms of power quantities and it is likely that applications of these phenomena will remain in the fields of control where such remarkable progress has already been made. The reason for this conclusion is that only a very small proportion of the free electrons in a metal mass is released when emission is caused. At the metal surface there is a "potential barrier," through or over which electrons can get only with great difficulty. The electromagnetic theory of light fails, and the quantum theory must be used, to explain photoelectric phenomena. Contrary to the electromagnetic theory, the energy of electrons in this kind of emission depends on light wave length or frequency, not on light intensity.

To build an electric generator on the piezoelectric principle capable of delivering 60-cycle current at 1 amp. and 100 volts would be quite a job, said Walter G. Cady, Wesleyan University. It would cost about $1 million and would require about 1,500 sq. ft. of crystal surface. Such a machine might take shape as a stack of crystals 1 ft. square and 10 ft. high. Operating on the stack would be a ram moving up and down $\frac{1}{64}$ in. with a compressive force of 100 tons. Therefore, concluded Dr. Cady, the power supply industry need have no immediate fear that its present generating units will be made obsolete by piezoelectric machines.

For those whose ideas of mechanical forces exerted by electrostatic fields were based on the movement of the leaves of an electroscope—probably most of those attending the conference—the paper by John G. Trump, Massachusetts Institute of Technology, was an eye opener. According to his disclosures economic production and utilization of electricity at extremely high voltages and extremely low amperages are definitely within the range of possibility. Since machines for such use would require no magnetic circuit their mechanical design would be very simple. The big problem is insulation. High vacuum appears presently to be the most promising way towards its solution and laboratory experimentation in this direction is now being carried on. Resulting from these investigations may be electrostatic generators and motors equal in compactness to present electromagnetic machines. Peering even farther into the future, Dr. Trump saw the possibility of direct production of electricity from nuclear fission without the intermediate heat cycle which is now necessary.

Distribution Continuity

Concerted stress is being put on the task of bringing the reliability of distribution systems nearer to parity with that achieved for generation and transmission. That the very diffusiveness of the problem is what has delayed a more universal remedy was also brought out in this conference session.

Difficulty in getting outage and trouble records persists but some

companies have systematized and intensified their efforts, particularly in the rural areas. Urban areas reflect a higher proportion of short-duration outages than rural. Most of the difficulties arise on the primary circuit; one company reported 15 percent due to trees and automobiles, 35 percent to lightning, 35 percent to contacts and 15 percent scattering causes.

Prominent among the remedies are off-highway routes, ample conductor separation and use of bare wire wherever feasible because it is less to burn down than covered wire. Use of the improved covering in urban areas was reported more effective than anticipated. New fast opening reclosers promise gains and the one-cycle short-circuit trials are indicating progressive benefits.

Relay Coordination Extended

An Eastern utility reports gains in continuity by extending the coordination of relays and breakers from the generators right through to the customer's fuses. Three-shot cutouts are not warranted on compact territories and this company said that even more than one reclosure is not justified economically but is a potential source of trouble due to complexity of mechanism. Fuses have been improved but it is still necessary to adhere to one manufacturer because of differences between lines. Tests found silver-element fuse superior to tin.

Solidly grounded neutral in conjunction with ground relaying on about one-fourth the circuits in one Eastern city has cleared faults rapidly and allowed higher rating for the overload relays whose capacity had been exceeded by load growth.

A Midwestern utility uses instantaneous phase and ground relays with overload relays for backup and has reduced fuse blowing from an index of 66 to 14 with proportionate increase in circuit breaker functioning.

The cooperatives have a real problem in bolstering continuity on systems that average some 600 miles apiece with average lockouts of more than three hours. Of 284 reported, twelve continued for more than 20 hours. The problem resides in the circumstance that the average recloser is 17 miles from a service center. Equipment is needed to afford prompt notification of outage and effective means of locating faults on open wire lines. Experimental carrier devices are being pushed; one of them adapts radar pulse technique, perhaps the first intrusion of radar in the power field. Another scheme uses carrier to indicate changes in circuit impedance when a branch is isolated because of faults.

Power for Welding

Essence of the informal papers at this conference session was a definite indication that power companies are going farther than ever before to accommodate resistance welding loads. As one participant said, there is too much at stake economically to permit misunderstandings or inadequate knowledge to throttle an art "that carries considerably other industrial and community loads along with it." The purist intent on perfection in rates or in voltage is often oblivious to this point. Welding was emphasized as a load that is impracticable for a small industrial or municipal plant to handle smoothly enough. On the other hand, industrial plants gain so much benefit from application of resistance welding that energy and associated charges are often inconsequential. One utility uses the a.c. calculating board to determine the short circuit capacity at any point and from it ascertains how much welding can be carried.

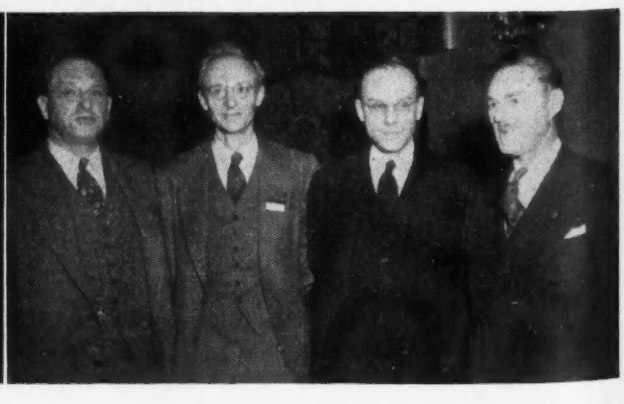
Interconnected Systems

Theoretical Approach to Speed and Tie-Line Control. R. Brandt, N. E. Power Co.

Minimized false moves and each section handling own load changes best achieved by tie-line bias control.

With the war over and less occasion for resorting to expedients, the time has come to take a long look ahead to see where interconnection operation will be projected by the current rise in loads. This was the recommendation of the first speaker, who led off with a discussion of the technical and "political" factors involved in present operations. By "political" he referred to politics within a participating utility and between those with which it is interconnected. First he asked pointedly whether many utilities have a clear-cut idea of the objectives of each interconnection or of the measures available to determine the degree of attainment of those objectives. Undoubtedly those responsible for the establishment of the interconnections are equally responsible for the vagueness about their primary purpose whether (1) diversity, (2) economic loading, (3) absorption of load growth, (4) spreading of load, (5) derivation of incremental differen-

J. J. Gerard, Indiana & Michigan Electric Co.; J. F. Fairman, Consolidated Edison Co. of New York; J. H. Schumann, Smith, Hinchman & Gryls; R. C. Buell, General Electric Co; E. C. Brown and D. Z. Stremlau, Connecticut Valley Power Exchange; P. H. Hatch, New Haven R. R., and J. F. Walker, General Electric Co.



W. R. Smith, Public Service Electric & Gas Co. (New Jersey); Joseph Slepian, Westinghouse Electric Corp.; K. B. McEachron, General Electric Co.; H. D. Wolf, Duke Power Co.; M. M. Samuels, REA; J. B. McLean, Burns & Roe; F. H. Kasten, Allis-Chalmers.

tials, etc. Whenever the focus is not specifically upon the dominant one or two of these, there is a loss chargeable to political diffusiveness.

Further discussion led to the suggestion of centralization of steam and electric controls to weaken such "political" differences of opinion as arise within stations.

It was also pointed out that the nation's electric systems are now being operated essentially as five major interconnections and that pending moves might easily result in reduction to three or even two.

Mutuality Desirable

Another paper detailed the successful methods used in the Northwest and other pools based on candor, latitude and mutuality. Fundamentally important are communication and telemetering along with the customary automatic controls for frequency and tie-line loading.

Suggestion was offered that some unnecessary adjustments of load by operators could be avoided if blocking signals would inhibit such devices during periods when local conditions were within prescribed bounds. Other discussion deprecated the idea because operators must be left ample autonomy or they will not be familiar when emergencies arise.

High praise was accorded Brandt for his paper, deemed a worthy sequel to his classical paper of 1929. It was recommended by several discussions as a superior source of clarification of the principle of the slope of the generation-speed line.

Less emphasis was placed on refining governors and more on the contributions of the control devices.

In fine, the session carried throughout the sentiment that the improvements needed are fully as much in the realm of administration of the interconnection as in the equipment or expert personnel available. One speaker said that interconnection contracts ought to be two-page documents which contained only (1) a letter of introduction between operators and (2) power of attorney to the operating committee. Under such procedure the interconnection participants could proceed to make "their living out of their respective customers and not out of one another."

Lightning and Transmission

Field Investigation of Lightning Surges at Substations. I. W. Gross, A.G.&E. Service, and G. D. McCann, Cal. Inst. of Tech.

Extension of 1942 paper includes crest surge voltages at seven 12- to 132-kv. substations. Arrester discharges 0.2 to 6 times per year. Arresters found to supply required protection.

Photographic Study of Lighting. J. H. Hagenguth, General Electric.

Many strokes found to have long duration; continuing currents are frequent.

Field Research on Lighting Arrester Discharges. G. D. McCann, Cal. Inst. of Tech., and E. Beck, Westinghouse.

Seven-year study, 19 substations, 133 arrester-years, 226 records. Statistical distribution in curve form.

Burning of Wood Structures by Leakage Currents. P. M. Ross, Ohio Brass.

Details devices to shunt leakage around vulnerable areas of variable moisture content or rain shielding.

Meteorological Engineering for Electric Utilities. H. A. Downs, U. S. Dept. of Commerce.

Outlines service available from government and other sources.

The Transient-Energy Method of Calculating Stability. P. C. Magnusson, Ore. State Coll.

Each machine represented by constant-magnitude voltage behind fixed reactance. Rotor-displacement energy is crux.

Internal Corona Discharges in Insulated Cables. E. W. Greenfield, Anaconda W. & C. Co.

Detector developed for harmonics associated with corona. Portable, self-contained, up to 30 kv. Shielding methods compared (carbon-black favored).

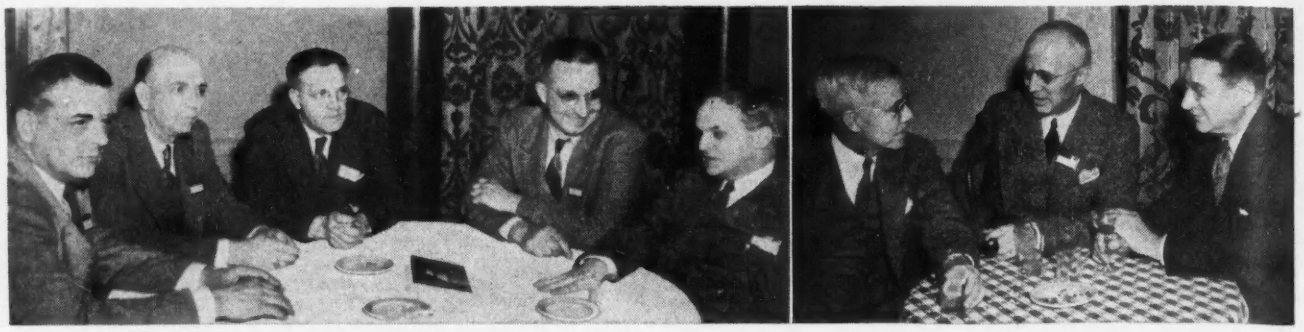
Radio-Noise Influence of 230-Kv. Lines. H. L. Rorden, Bonneville Pwr. Adm.

Experience on 185-mile, H-frame wartime line with 13 standard 5¾-in. insulators, no ground wires.

Sharpened values of discharge currents, polarity proportions, durations and rates of rise were conveyed in the three lightning papers along with new data and digestion and correlation of earlier data. P. L. Bellaschi, Westinghouse, said the reference values chosen on the strength of these earlier data seem now not to be far from the appropriate bases for basic insulation levels. The Gross-McCann paper was said to confirm the prevailing precept that arresters must be placed as near as possible to the protected equipment.

H. L. Rorden, Bonneville, was not too sure, however, that available lightning data are sufficiently rationalized to give complete assurance for new line design. The Northwest, he said, is to have numerous new lines and many will initially carry relatively small loads. In these instances the economic factor is critical and the cost of lightning protection possibly the crucial factor. He implied that the quantitative aspects of branching might throw clarifying light on the present variabilities of lightning.

Active interest was aroused by the Ross paper on leakage currents. G. L. Brownlee, Commonwealth Edison,



M. W. Smith, Ohio Edison Co.; A. L. Richmond, Ohio Edison Co.; E. F. Dissmeyer, Commonwealth & Southern Corp.; Stephen Freeman, Consumers Power Co.; C. T. Burke, General Radio Corp.; F. V. Magalhaes, Consolidated Edison Co. of New York; W. B. Kouwenhoven, Johns Hopkins University, and C. R. Beardsley, Consolidated Edison

dissented from the author's assumption that the resistance of the wetted portion of a pole is negligible; he also asked why poles will burn in mere fog, without wind and without the rain shadows stressed by Ross. M. S. Oldacre, Utilities Research Commission, envisions a field of development for insulators to be used in contamination areas and hold leakage currents below flame-initiation levels. Further than this sound consideration should be given, he said, to the durability of the suggested shunting devices and the persistence of contact with a pole that continues to shrink. Also he pointed out that judicious placing of phases on dual circuits will alleviate leakage effects.

Pole Burning Erratic

Weaver, Andrews and Caswell of Public Service of Northern Illinois mentioned the erratic occurrence of pole burning—two-thirds of 60 accumulated records on 33 kv. have happened in the past two years; one-third of the cases happen on corner poles. Creosote seems to make little difference nor does a down-wire to ground. They prefer a small-wire shunting arrangement because it promises better contact with a drying pole than a broad strap.

Protective Devices

The Interruption of Charging Current at High Voltage. W. M. Leeds and R. C. Van Sickle, both Westinghouse.

Effect of circuit constants and interrupter design on magnitude of switching surges. Prevention of restrike. Merits of paralleled resistors.

Resistors for 138-Kv. Cable Switching. E. K. Sadler, Kelmann E & M Co., **and T. M. Blakeslee,** City of Los Angeles.

To limit overvoltage by restrike when opening capacitive circuits, an 800 to 2,000-ohm resistor is used.

An Improved Automatic Circuit Recloser. J. M. Wallace, Westinghouse.

Range of coordination extended by high speed tripping and reclosing. Time lag third and fourth trips followed by delay reclosure and lockout respectively.

Sectionalizing and Internal Transformer Fusing on Rural Power Circuits. B. O. Watkins, REA.

For coordination recommends link standardization, better link characteristics and coordination of reclosers with transformer protection. Extensive tables.

Commenting on the Leeds and VanSickle paper, T. M. Blakeslee, Los Angeles Department of Water and Power, rather deprecated the optimism of the authors in minimizing the possibility of serious overvoltages in breaker operations. The user, he said, knows from experience that if a thing can happen, some day it will and therefore is waiting not for a breaker that probably won't restrike, but for one that definitely will not, and which will be in a reasonable price range. H. W. Haberl, Quebec Hydro-Electric Commission, did not agree that breaker speed has no effect on overvoltages and reported that he had seen high voltage rises in operations of oil breakers, but not of air breakers. The oil impulse breaker, said E. B. Rietz, General Electric, does not restrike and thus is the best answer for capacitance switching, but rather expensive.

Higher interrupting capacities will be required of reclosers such as described in the Wallace paper, in view of rapidly growing loads on rural lines, said C. E. Asbury, Illinois Power, and they can be improved by more flexible setting arrangements. And why, he asked, can they not be designed for 1- or 2-cycle operation, instead of 15 or 20? R. F. Quinn, W. J. Rudge, and G. F. Lincks, all General Electric, commenting on the Wallace scheme, emphasized the difficult problem of coordinating fuse and recloser operations, questioned the effectiveness of the protective gap incorporated in the device, and asserted that with the scheme proposed 20 to 25 percent of consumers would get an inferior grade of service. R. M. Smith, Railway & Industrial Engineering, said that the new recloser's tripping sequence was not ideal, that the second operation did not seem justified. L. M. Olmsted, Duquesne Light, commented that the perfect recloser, capable of accurate coordination with fuses, was still in the future.

Power Relays

Grounding of Instrument Transformer Secondary Circuits. H. R. Paxson, Group Sponsor.

Recommends grounding of case and secondary, with insulated wire (not via station ground copper) and other desirable practices.

Fundamental Basis for Distance Relaying. W. A. Lewis and L. S. Tippett, Ill. Inst. of Tech.

Symmetrical-component mathematical formulation for fault currents and impedances, systematic errors. Proposes delta relaying, compensation.

Experience with Single-Pole Relaying and Reclosing on a Modern 132-Kv. System. J. J. Trainor and C. E. Parks, Pub. Serv. Co. of Ind.

Three-year report shows improved stability, lengthened time for deionization, reduced system disturbance.

While finding cost of single pole relaying and reclosing, of the type described by Trainor and Parks, quite expensive, Frank V. Smith, Sargent & Lundy, asserted that its use on long lines appeared advantageous, particularly where stability could be improved. Comparison of cost of three-pole and single-pole reclosing is inevitable, in the opinion of W. A. Derr, Westinghouse, who doubted that the

present high reclosing speeds can be improved substantially in view of the time that breakers must stay open to prevent restrike. A joint discussion by Philip Sporn and J. H. Kinghorn disclosed the contrasting view that the best reclosing times of the present could be reduced by several cycles without serious difficulty. They felt that the single-pole reclosing breakers did not perform as well as modern three-pole breakers on multi-pole operation. If system stability is not involved, and economy is disregarded, performance of single-pole reclosing and three-pole reclosing are about on a par. However, with single tank high-voltage switches in prospect there is nothing that will provide more effective fault clearing per dollar than three-pole breakers. R. L. Witzke, Westinghouse, called attention to the shaft torque imposed on generating units with high-speed reclosure. There may be a limit, he cautioned, to the reclosing torques that a machine can stand. Single-pole reclosing limits the magnitude of this torque and for this reason may be more desirable than three-pole reclosing.

Gas Actuated Relay

Simplicity, high sensitivity and ability to detect incipient faults were cited as advantages of a gas-actuated relay (Buchhobtz principle) for transformer protection in a conference paper by E. T. B. Gross of Illinois Institute of Technology. The relay is actuated either by the accumulation of gas liberated from insulation as the result of an incipient fault or by gas pressure in the event of a short circuit. F. L. Lawton, Aluminum Co. of Canada, reported operation of such relays to be as fast or faster than differential relay protection. He cited parallel instances of similar faults on identical 110-kv. transformer banks, one protected with gas relays, the other not. Cost to repair the unprotected transformer was $6,200; the protected one $700. B. C. Hicks, Shawinigan Water & Power Co., reported 45 installations of gas relays on transformers ranging from 13,000 to 50,000 kva. and having an aggregate rating of 670,000 kva. After 265 transformer years of satisfactory operation there have been no instances of failure to operate on fault but several instances of operation on no fault.

Rural Telephone Facilities

A Carrier Telephone System for Rural Service. J. M. Barstow, Bell Tel. Labs.

Further details of correlation with power circuits and of coupling units and calling procedure.

Application of Rural Carrier Telephone System. E. H. Bartelink, Gen. Tel., **L. E. Cook,** Ebasco, **F. A. Cowan,** A.T.&T. **and G. R. Messmer,** REA.

Effect of power system modifications on operation of power system; construction features.

Joint Use of Pole Lines for Rural Power and Telephone Services. J. W. Campbell, A.T.&T., **L. W. Hill,** Car. T&T, **L. M. Moore,** REA, **and H. J. Scholz,** Com. & Sou.

Describes new methods, electrical protection and coordination to facilitate higher-voltage joint use.

Rural Radiotelephone Experiment at Cheyenne Wells, Colo., J. H. Moore, A.T.&T., **P. K. Seyler,** Mtn. St. T.&T., **and S. B. Wright,** Bell Tel. Labs.

Eight ranches (11-21 miles away) served over 44-50 mc. band from conventional central office.

Excellent collaboration between the telephone engineers and those of power systems, both urban and rural, has been manifested throughout the developments recorded, as attested by all contributors to the symposium. The spirit was one of overriding technical impediments at every step so that telephone service as well as electricity can reach every farm. Reports indicated good results from the communication services, some of which were first instituted during the last year.

Some factors, however, will need further experimentation and development and one is the high decibel loss in the series coils of reclosers. It appears that it will be necessary to provide bypasses for them and to arrange them so that the line will be positively deenergized when it is intended to be open. This is being negotiated with manufacturers of reclosing devices.

Who is to be responsible for detection and correction of whose equipment when communication is coupled to the power lines is something still to be routinized, commented W. R. Brownlee, Commonwealth & Southern. Also when noises arise it is less easy to identify their source by killing a suspected circuit because that would kill the carriered telephone as well.

In connection with the joint use paper, H. J. Scholz supplemented its data by stating that a 75-mile piece necessitated the following changes or additions to the existing power line: Added poles, 3.7 percent; poles replaced, 8.1 percent; poles relocated, 0.63 percent; transformers relocated, 29. It was concluded that this degree of modification was not excessive. Shortage of timber and occasional right-of-way difficulties are joining at present to make such joint use economically justifiable.

R. J. Wiseman, and C. Neudoerffer, Okonite Co., and C. A. Mullen, Jersey Central Power & Light Co.

Limitations of Light Production

Although the possibilities of improvement in light production efficiency are much greater for fluorescent and other discharge lamps, the incandescent lamp will not soon nor easily be displaced from its position of leadership as a source of artificial light, said Samuel G. Hibben, Westinghouse, in his opening remarks as chairman of the conference.

First speaker was R. G. Slauer, Sylvania, who indicated possible developments in incandescent lamps in the next ten years. Today's lamp is 2 to 3 percent efficient—output of usable light energy over electricity input. To raise that range of efficiency to 3 to 4 percent would be tremendous progress, but is hardly likely in ten years. No change from tungsten as filament metal is foreseen, although its performance may be bettered by alloying with other metals. Alloying and possibly case-hardening of the filament surface may permit operation at higher temperature with resulting greater light output. Increased output could be attained by using krypton in the bulb

G. W. McIver, Toledo Edison Co.; C. W. Fick, General Electric Co., and T. J. Williams, Ohio Power Co.

instead of nitrogen. An increase of efficiency of about 20 percent—that is, 20 percent of 2 to 3 percent—could thus be obtained, but at 6 or 7 times the present cost of the lamp. Other possibilities for raising light output efficiency are increasing gas pressure inside the bulb and incorporating fluorescent effects to push infrared radiation up into the vision range.

Metallic Arcs Promising

There still remains a wide area for exploration in the production of light from metallic vapor arcs, said H. C. Rentschler, Westinghouse, but nothing yet exceeds the promise of mercury. The amount of visible light given off by a mercury arc increases with the current density of the arc, and increasing also are the pressure and temperature of the vapor inside the enclosing envelope. This envelope is usually a quartz tube. The limitation on light output is the temperature at which the tube begins to melt, about 3,000 deg. F. for quartz. Compounds of magnesium and aluminum oxides which have a higher melting point than quartz have lately become available and may make it possible to operate the arc at higher temperature and thus increase the light output. But so far these compounds have been most recalcitrant as regards sealing and until that difficulty has been overcome, the melting point of quartz will continue to set the upper limit of light production from the mercury arc.

Future improvements in fluorescent lamps are possible in several directions, stated R. N. Thayer, General Electric. Efficiency of conversion from ultraviolet to visible light is not likely to rise above the ranges already established for various phosphors and their characteristic colors. But the efficiency of ultraviolet production can and probably will be raised. Another gain may be realized by improvement in maintenance of lumen output, that is, avoidance of the present decline in output that occurs in the first 100 hours of use. Definitely coming is the complete elimination of starters and improvements are on the way in lamp, ballast and fixture design which will greatly reduce sensitivity to low temperatures. The use of higher frequencies would lessen flicker greatly, reduce ballast sizes and permit new circuit possibilities, but this change can hardly be looked for, at least not very soon.

Hydroelectric Systems

Testing Governor Performance on Electric Power Systems with Improved Instruments. J. E. Allen, Pa. W&P Co., and W. B. Hess, Safe Harbor W.P. Co.

Plots frequency vs. operating piston or vs. kw. to deduce sensitivity, dead band, speed droop and regulation.

Automatic Control of Hydroelectric Generating Stations. M. J. Brown and W. A. Derr, both Westinghouse.

Discusses basic requirements and equipments, followed by analysis of governor, regulator, synchronizer, protection and supervisory.

Modern Bearing Practice for Vertical Water Wheel Generators. C. M. Laffoon and R. A. Baudry, both Westinghouse.

Analyzes design and production of three basic types and recommends conservative operating precautions.

The Allen-Hess device for charting governor performance drew almost universal praise at the hydroelectric session. Avery, Woodward Governor Co., saw in its production of essential chart and strip diagrams a means for speedier testing. Guided by such a recorder, he felt, programmed maintenance offered means for catching troubles before they affect the governor. The authors conceded that the instrument might show substantial drift over a period of days, but repeated that its purpose was to determine frequency variation over short periods of the order of 10 minutes, not days. F. Oppenheimer, Pennsylvania Water & Power, disclosed three methods for testing governor performance over the entire frequency range using the Allen-Hess device. All three procedures require removal of the turbine from operation. He applauded the usefulness of the recording device for comparing governor performance before and after maintenance. With the charts, he noted, effectiveness of maintenance can be verified by eye, without extensive measurement and test.

While agreeing with Laffoon and Baudry that initial starts of new vertical waterwheel generators are critical where thrust bearing performance is concerned, T. W. Gordon, G. E., felt that all starts after the first several should be devoid of hazard. Whereas the authors favored jacking up the rotor, prior to starting, to establish an oil film on bearing surfaces, Gordon and other discussers favored reliance on pumping to force oil between the surfaces. Jacking the rotor requires quick opening of the gates after jacks are released. E. I. Pollard, Elliot, cautioned that the vacuum between runner and shoe might pull babbett away from the shoe where jacking was restored to. B. Van Ness, Pennsylvania Water & Power, pointed out that jacking was not always possible with some machine designs.

Automatic Stations

Automatic Control of Air Switches for Line Sectionalizing and Load Transfer. F. W. Rich and M. S. Kirwen, The Com. & Sou. Corp.

Defines both objectives. Full details of three schemes using d.c. or a.c. for operation and control.

Automatic Switching Schemes for Capacitors. W. H. Cuttino, Westinghouse.

Discusses comparative advantages of (1) varied voltage (2) on-and-off with motor, (3) tap-changing and (4) step-switching to adjust capacitors to kvar. needs.

The Economics of Using Capacitors in Amounts to Require Automatic Switching. J. W. Butler, General Electric.

Kilovars cost one-fourth as much as in 1930. Discusses optimum system power factor.

Rather than rely on 95 percent power factor operation of generators for part of system kvar. needs, E. M. Porter, American Gas & Electric Co., reported that generators on that system are operated at unity power factor with reliance placed on synchronous condensers for kvar. requirements where needed. He felt $8 per kvar. for transportation of reactive to load centers was more nearly accurate than the $10 cited by

Butler and that the economical size of switched capacitor banks lay between 5,000 and 10,000 kva. Conviction that switching of capacitors is economical mostly at lower voltages was expressed by W. R. Brownlee, Commonwealth & Southern. O. B. Falls, G.E., countered Butler's emphasis on large banks. In his opinion the best place for capacitors is out on the system where lies the higher percentage of total system cost. Unswitched banks out on the system, Falls felt, can be backed up as needs required with switched banks on substation buses.

H. N. Reardon, commenting on the Cuttino paper, reported the existance of twelve outdoor capacitor banks on circuits of the West Penn system ranging in voltage from 23 to 25 kv. On these banks switching has been applied as needed but only one of the dozen banks is completely automatic. The single 25-kv. bank is tapped through a breaker controlled from an adjacent station and comprises six 2,400-volt units in series and twelve such groups in series.

Twenty installations of automatic control of air switches for line sectionalization and load transfer, similar to those of the Rich and Kirwen paper, have given satisfactory operation on the American Gas & Electric system over a period of years, according to F. M. Porter. He stressed the importance of periodic testing however, as insurance against trouble. In nearly all A. G. & E. installations, 24-volt batteries have been used for motor operation. In one instance three installations of automatically controlled air-break switches exist in a single line between source and load. This was topped by H. N. Reardon, West Penn, with the disclosure that one line on his system has five such installations. He also reported the use of automatic air-break switching on 132 kv. in two instances for transformer protection. Duquesne Light is operating "25 or 30" automatic air break switching installations, according to George B. Dodds.

Light Traction

Can the Trolley Coach Compete Economically with the Gas or Diesel Bus Where No Overhead Facilities Exist? J. H. Gauss, General Electric.

Conclusion favorable when 2-10 min. headway is necessitated for handling 400-2,000 per hour. One line equivalent to seven-lane highway. Fewer units required, fewer spares. More than doubled return on investment in mechanical buses.

G. S. Rose, General Electric Co.; Harold C. Dean, Consolidated Edison Co. of New York; S. G. Hibben, Westinghouse and J. G. Tarboux, Cornell Univ.

Better riding, better public satisfaction and better return on investment were emphasized as the essence of the trolley coach potentiality by Gauss after he had answered several queries about allergy to diesel fumes, interference of overhead wires with fire-fighting equipment and public reticence about restoring overhead once the trolley wires have been taken down. In case of serious fires the wires have been cut down and replaced a couple of hours later, meanwhile towing coaches through by trucks. Advantage in acceleration and smooth starting, even over buses with fluid-drive, rests on the greater reserve power of the trolley coach, said the author, adding that power companies are taking more interest in the load as a desirable one.

Instruments, Measurements

Advancements in the Design of Long-Scale Indicating Instruments. R. M. Rowell and N. P. Millar, both General Electric.

War developments toward easier reading, facilitated calibration and repair, consistent accuracy.

A Polyphase Thermal Ampere Demand Meter. A. J. Petzinger, Westinghouse.

Kva. demand derived by multiplying by assumed base voltage.

Since the demand meter described resolves unbalanced currents and phase values into a single average or equivalent, G. G. Waite, Sangamo, Ltd., Toronto, asked whether it was desirable to eliminate the factor of unbalance in arriving at demand. He pointed out that straight ampere demand is much easier to handle both in design of the instrument and in its calibration.

Industrial Control

Shading Coil Calculations for Single-Phase Magnets. C. T. Evans, Cutler-Hammer.

Approximate solution for watt loss deduced from flux analysis.

A Thrustor Lowering Control System for A.C. Crane Hoists. E. L. Schwarz-Kast, Ill. Inst. of Tech.

Tabulates prevailing art and limitations, describes thrustor brake control with wound-rotor hoist motor.

Dynamic Braking by Self-Excitation of Squirrel-Cage Motor. A. Srinivasan and M. A. Thomas, N.M. St. Coll.

Experiments reported; P. F. correction capacitors can be used for excitation.

Dynamic Braking of a Single D.C. Series Motor. J. D. Leitch, The Elec. Contr. & Mfg. Co.

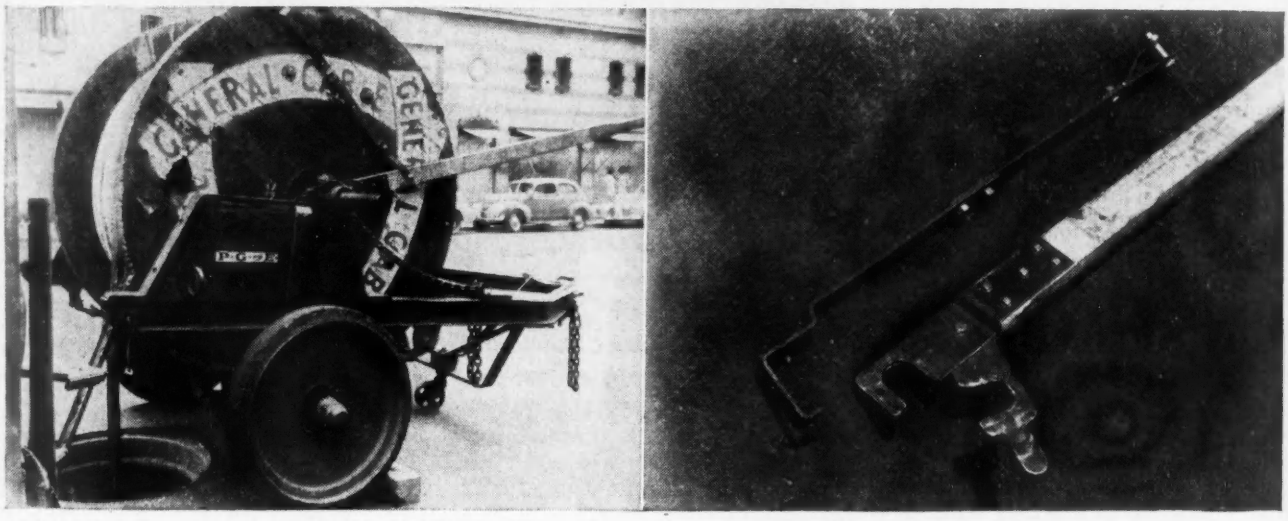
Polarized spring-closing contactors for power failure; either direction of rotation. Circuits in functional detail.

Thrustor control was used on a harbor crane in Berlin as early as 1935, and used in this country during war years on several hundred shipyard cranes, reported G. W. Heumann, General Electric Co. Inapplicability to lowering long distances at low speed but excellent inching performance is inherent characteristic of this control method. Schwarz-Kast rates brake capacity 150 to 175 percent of full-load torque, others advise up to 200 percent. Brake has less heat duty in ordinary lowering operations than with other methods of control. Heumann suggests further study of oscillations during lowering and survey of need for cushion or buffer springs.

HOW

DESIGN • CONSTRUCT • OPERATE • MAINTAIN

One-Man Reel-Turning Device



LEVER TURNS CABLE REELS—Simple device enables one man to turn heavy cable reels by rachet motion

W. F. QUINN
Pacific Gas & Electric Co.
Oakland, Calif.

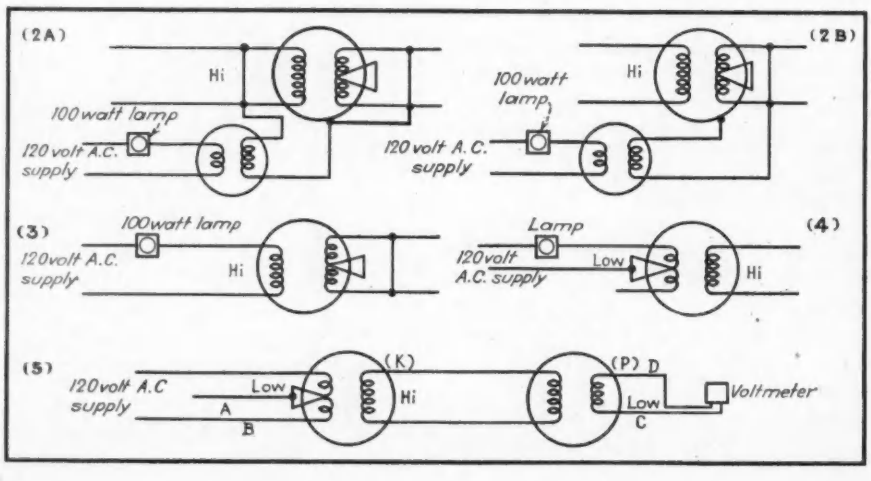
BY USING the cable-reel-turning lever shown, one man can turn reels weighing up to nine tons. Three or four men would be required to turn some of these reels without the lever, particularly where large cables are being reeled or unreeled. Sufficient detail is shown in the illustrations to indicate how the device is made.

The lever arm is a piece of selected pine, 8 ft. long, to the end of which is fitted the supporting and clamping device that attaches to the cable reel shaft. The metal arm, made of ½x2 in. stock, which clasps the rim of the cable reel is made in two pieces with a series of holes in each to permit varying the length for different diameter reels. One end is formed into a clasp and the other is made into a clevis for attachment to the wooden lever and serves as a ratchet.

• • •

Tests of Distribution Transformers Made with Lamp

R. A. CALDWELL, Distribution Engineer, Interstate Power Co., Dubuque Iowa



THE FOLLOWING PROCEDURE outlined on an instruction sheet for district line crews shows how distribution transformers are checked in the store-room, without elaborate testing facilities. Connection diagram numbers refer to respective paragraphs.

1. Make thorough visual inspection —oil level, leaks, broken cover, broken bushing, broken tap block, tight cover and hanger bolts, etc.

2. Test for insulation:

(A) Primary to case and secondary. Supply transformer must supply high-side voltage equal to high-side

voltage of transformer being tested.

(B) Secondary to case. Supply transformer always 20/1 ratio for secondary insulation test.

If 100-watt lamp lights in either Test (A) or (B), it indicates transformer insulation is bad.

Make visual inspection to locate break-down; check bushings. Breakdown may be external to transformer windings and can be easily repaired.

3. Test for opens in windings: If 100-watt lamp does not light, it indicates transformer under test is open in the primary or secondary winding.

Make visual inspection; open may be in a lead or on the tap, in which event it can be easily repaired.

4. Test for shorts in windings: First try lamp in series with a transformer of same size known to be O.K. Use a large enough lamp so that it glows red only when in series with low-side winding of good transformer. When lamp is placed in series with questionable transformer, it will light up to nearly full brilliancy if the transformer is shorted.

Make visual inspection; look for shorted lead wires, burnt terminal blocks, burnt coils. If external to windings, repairs may be possible.

5. Test for ratio:

(K) Transformer of unknown ratio being tested.

(P) Potential transformer or other transformer of known ratio thought to be the same as transformer under test.

• • •

An ELECTRICAL WORLD *Comparison of Practice*

Fitting the Primary to the Regulator Rating

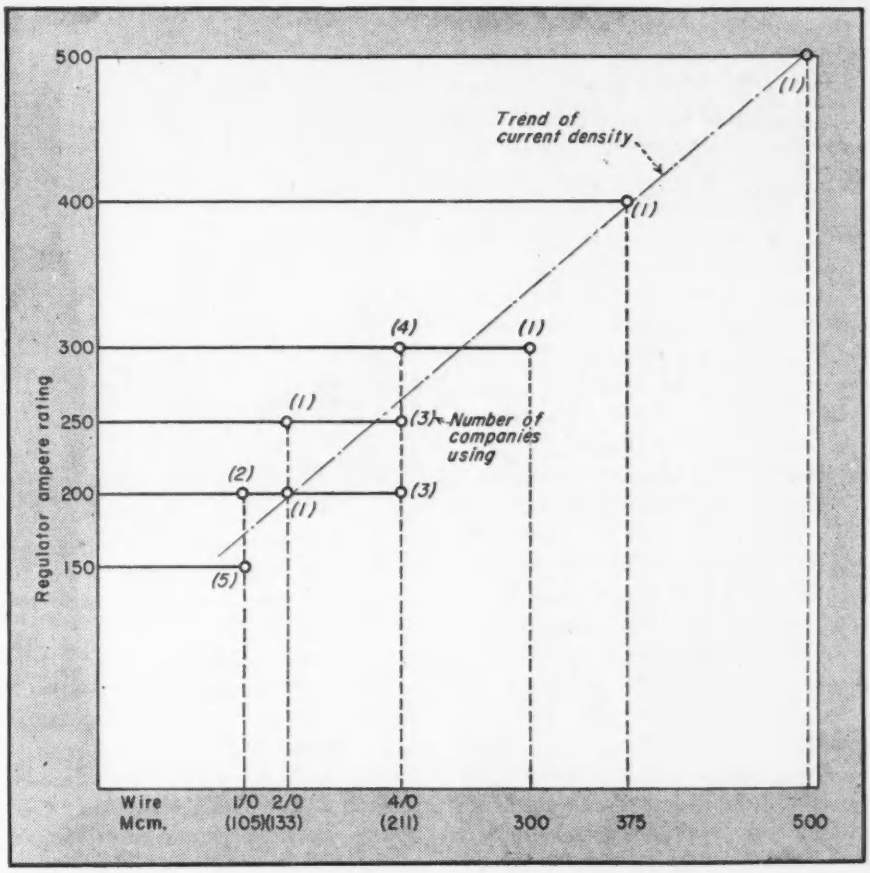
THEORETICAL CALCULATIONS would indicate the best combination of regulator rating and primary wire size design for a given set of load and distance conditions in a particular distribution area. The substation and feeder installation could be made exactly right from the standpoint of both voltage regulation and economics.

The only catch to this approach is that the conditions change from one feeder to another on any one system and over a period of years on any one feeder. Practices have been more the results of operating experience, records of growth and expansion, and judgment through the years. The practical requirements of circuit additions and rearrangements and the need to have spare units of regulators and other equipment have been larger factors than the theoretical calculations.

Practical Combinations Vary

As would be expected, practices vary considerably in various cities. That they spread over a wide range of regulator ratings and wire sizes is shown in the accompanying chart, based on a survey of 16 distribution systems. Actual combinations represented total 21, with six companies using different arrangements for more recently installed feeders. These figures are for majorities of feeders already in service and do not necessarily indicate the ratings that will be installed during the coming years.

Seven companies have 1/0 wire as the predominant size in overhead construction. Four of these companies also have heavier lines in sections of their systems, three using 4/0 wire with higher regulator ratings. A total of ten companies use 4/0 and only two use 2/0 conductor. One company using 1/0 also uses 375,000 cir. mil. and one company that formerly used 4/0 has changed to 500,000 cir.mil.



REGULATOR ampere rating and primary wire size combinations are shown in this chart, with number of companies using each rating also indicated

These practices are all for average urban and suburban distribution in cities with residential customer energy use at about the national average. Unusually high consumption areas and sparse rural customer density sections are in general not included in the summary. All of the

companies include small commercial and industrial services on the same feeders with residential loads.

With the general average loading per customer being about the same, the number of customers served by each feeder would be expected to vary about in proportion to the load capacity of the feeders. Using the reported numbers of customers and of feeders is not necessarily accurate, however, because of other conditions. System averages vary from 700 to 2,000 customers per feeder, with 1,500 appearing to be about the average of all the feeders included in the lists.

Practices of all the companies are uniform in one respect. They try to avoid having more than one feeder on each pole line. All except one company rotates the connections of single-phase transformers on the three phases, the one using phase area layout of its feeders. All have individual regulators for each feeder, but three companies also have some feeders bus regulated. All indicate compensation to include secondary main and service voltage drop.

An important innovation noted is the supply of two smaller feeders from one regulator and switch position. This has been accomplished by reconnecting regulators for double-ampere rating, one-half voltage control range.

Actual ampere capacity of overhead line weatherproof wires is not a critical point, as it is in the case of inside wiring, and considerable variation is evident in the practices followed. The "trend line" shown on the chart indicates a weighted average and may emphasize the possibility of economy in heavier loading.

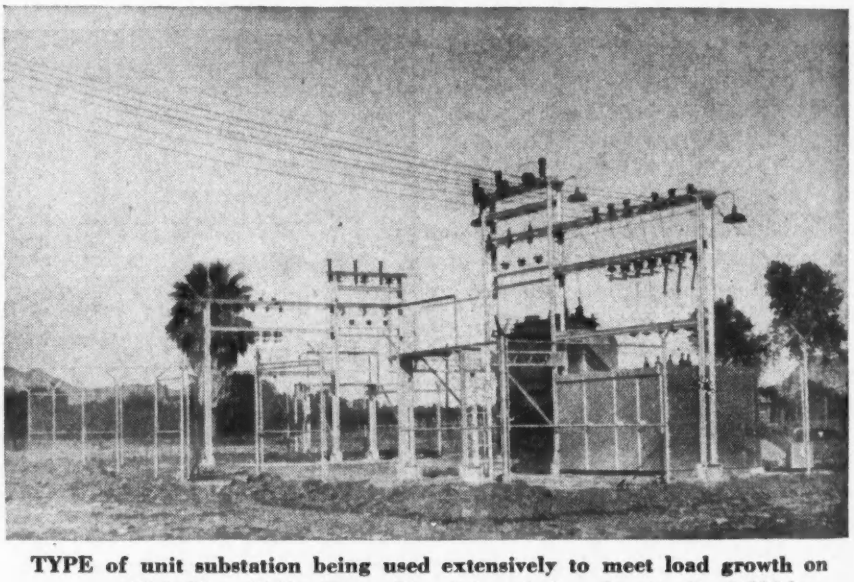
• • •

500-Kva. Unit Substations Adopted for Arizona System

In 1937 it became apparent that greater load per user and increased population on the system of the Salt River Valley Water Users' Association warranted consideration of unit substation equipment to care for the growth. This user-owned system serves the highly fertile agricultural area in central Arizona. Four 500-kva., 12,000- to 4,160-volt, four-wire General Electric units with load ratio control were installed. Distances, density and type of load determined that a 500-kva. unit would serve best. With air fields, defense plants and greater population during the war, the load rapidly outgrew facilities.

Consideration was given at that time whether to raise the voltage to 7,200/12,470 or retain the existing 4,160-volt, Y, four-wire system. Character of load and the desire to serve a regulated voltage were determining factors in retaining and extending the 4,160-volt primary system. The load character was still that of a rural area but with a growing density because of subdivision of acreages into smaller units and increasing numbers of subdivisions in the rural areas requiring service, each having from 25 to 100 homes.

The existence of an extended grid of 12,000-volt circuits serving industrial and pump loads made it easy to locate unit substations at any convenient point and also made possible moving or relocating with a minimum of difficulty. Calculations were made on the basis of kva.-miles, etc., and, considering mechanical as well as electrical limits on distribution circuits, the decision was made to retain and expand the 4,160-volt system with additional 500-kva. substation equipments.



TYPE of unit substation being used extensively to meet load growth on system of Salt River Valley Water Users' Association. Standardized 500-kva. units are fed from 12-kv. grid to serve 4,160-volt, four-wire primaries

Experience with the four original unit substations had shown that two feeder circuits per unit were proper and that they should be of the normal three-shot reclosing type. Because of length of exposed lines and outages due to storms and other causes, it was felt that two circuits should be served from each unit even though the kva. available could have been served on a single outgoing circuit. Better service to the customer was also a factor.

In selecting unit equipment it was felt that complete instrumentation and metering were desirable. This was accomplished by incorporating strip chart recording instruments in the feeder circuits to record voltage, kilowatts, reactive kva., and ampere demand. In addition, normal overcurrent relay protection with three-shot reclosing was provided. Seven more equipments were added during the war and others are now on order. Since the unit equipments are easily moved or relocated to accommodate changes in load or errors in forecasting, the association is well pleased with its choice of size and type of equipment and with the subtransmission and feeder voltages adopted.

The accompanying photograph taken by F. L. Roe, superintendent of power of the Water Users', shows a typical unit substation installation.

How to Estimate Replacements For Fluorescent Lamps

HARRIS REINHARDT, Manager, Commercial Engineering Dept., Sylvania Electric Products Inc., Salem, Mass.

THE AVERAGE LIFE of fluorescent lamps depends not only on the number of hours the lamps are operated but also on the number of times they are turned on and off. Thus the life of standard fluorescent lamps is rated on three different burning cycles as indicated in the accompanying table.

Burning Hours per Start	Lamp Life, hours	
	15, 20, 30 and 40-Watt Lamps	100-Watt Lamps
3	2,500	3,000
6	4,000	4,500
12	6,000	6,500

The expected lamp replacements in a given installation may be computed from this rated average life data by means of the following equation:

$$\text{Expected Lamp Replacements per Month} = \frac{\text{Number of Lamps} \times \text{Average Burning Hours per Month}}{\text{Rated Average Life of Lamps}}$$

For purposes of evaluating the performance of a fluorescent lamp installation, it is often desirable to express the expected lamp replacements in percent of the total lamps in operation. The accompanying chart provides a means of obtaining the solution to the above equation on that basis. This chart applies to lamps of all present standard sizes. Expected replacements are computed for periods of 3, 6, and 12 burning hours using the average life data previously given, and various figures likely to be encountered in actual installations for the number of starts per week. In order that the chart might be used for other burning cycles, the points were connected by a smooth curve on the assumption that the average life at other burning cycles follows a trend defined by the three points to which the published data apply.

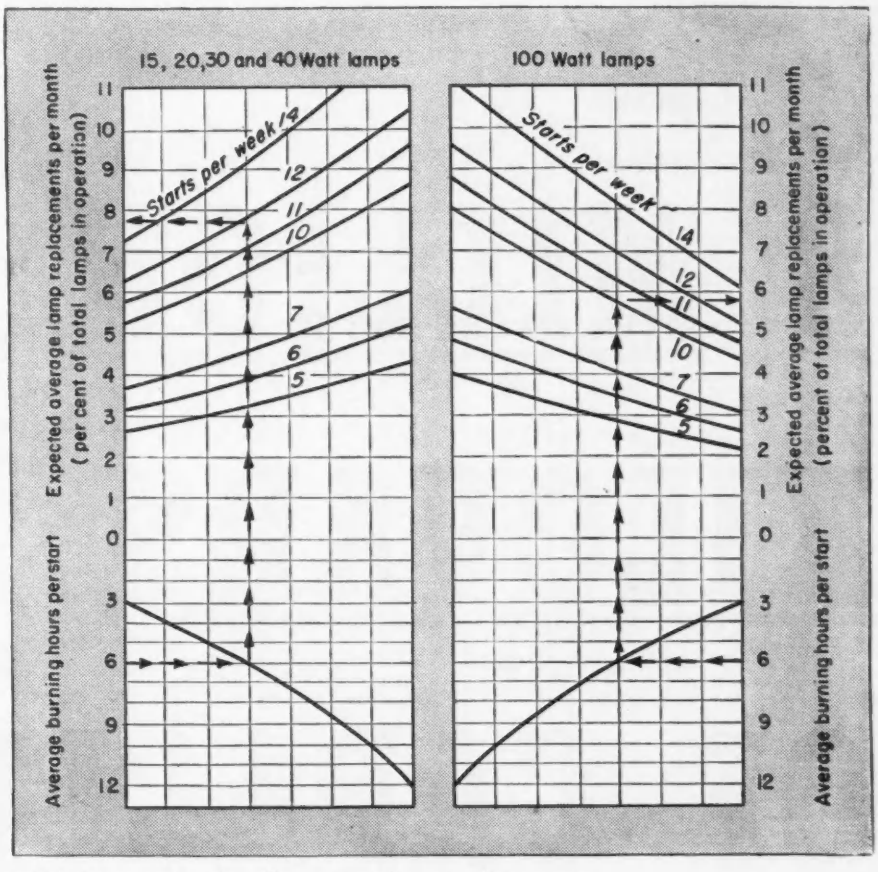

15, 20,30 and 40 Watt lamps
100 Watt lamps
Starts per week 14
12
11
10
7
6
5
Expected average lamp replacements per month (per cent of total lamps in operation)
Average burning hours per start
Expected average lamp replacements per month (percent of total lamps in operation)

CHART for estimating fluorescent lamp replacements

Example

Problem: Estimate the expected lamp replacements per month in an installation of 400 40-watt lamps which are turned on for two 6-hr. periods each day, 6 days per week, giving a total of 12 starts per week.

Solution: Starting with a value of 6 on the left-hand scale, "Average Burning Hours per Start," proceed as indicated by the arrows and obtain a value of 7.8 percent for the expected replacements per month.

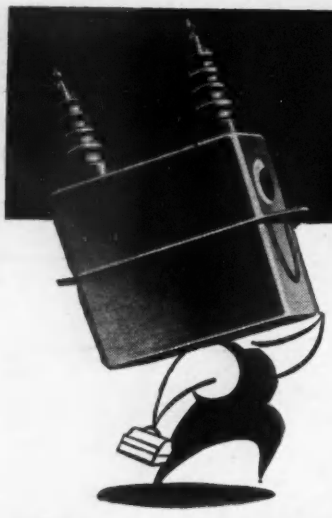
Expected lamp replacement per month is 400 x 0.078 = 31.2.

Another example indicated shows the percentage replacement for an installation of 100-watt lamps.

Lamp Performance

In evaluating the performance of any particular installation it must be realized that there will be significant variations from this average value from month to month. When an installation is first placed in operation the renewals during the first few months should normally be very small but as the total burning hours approach the rated average life of the lamp the renewal rate may become temporarily much higher than the average value. After the installation has been in operation long enough so that there have been three or four replacements for each lamp, the renewal rate should tend to settle down to a more nearly uniform value.

A convenient method for keeping a record of the performance of an installation of fluorescent lamps is to prepare a graph showing the replacements each month over a period of several months or years. A line showing the estimated replacements may be added to the charts to give a readily grasped picture of the actual performance of the installation in relationship to the expected performance calculated by the methods outlined above.



JOHNNY CAPACITOR'S

8 MILLION KILOVARS OF CAPACITORS CAN'T BE WRONG!

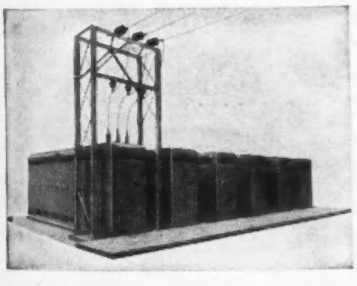
KILOVAR ECONOMICS #1

Johnny says:

"EIGHT million kilovars of capacitors have already been installed in the United States. With system investments in the order of $200 to $500 per kilowatt—and rising—this is the time to reduce your 'blue chip' system investment and, at the same time, obtain valuable additional system capacity by means of capacitors. You can get quick delivery and they can be installed for $10 a kilovar—*or less*!"

The cost of supplying on-the-spot kilovars has gone steadily downward. Today this cost is only 25% of what it was 15 years ago. Contrast this with today's rising costs of other equipment.

By eliminating the transportation of kilovars through your lines, and supplying them at the load by capacitors, additional line and transformer capacity—up to 10% of peak-load requirements or more—is immediately made available.



Such a move can permit postponement of investment in additional generating, transmission, and distribution equipment. There are also many other system benefits to be obtained, such as:

1. *Reduction of system energy losses and general voltage improvements.*
2. *Relief on overloads and low-voltage conditions on distribution circuits.*
3. *Reduction in average cost of purchased power.*

A General Electric specialist will be glad to work with you on the application of capacitors to your system. For further information ask your G-E representative or write to *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

APPLICATION OF CAPACITORS IS FLEXIBLE

Capacitors can be installed either on primary or secondary feeders, as a unit for a locality, or at a specific load center—such as a substation. They can be installed in large units with automatic switching, or as smaller units on distribution circuits for voltage improvement. Their cost is low. Installation does not disrupt operation. They are 100 per cent salvageable in case of changing requirements.

THESE COMPANIES ARE USING CAPACITORS

Typical of the companies now taking advantage of on-the-spot kilovar generation are Oklahoma Gas and Electric Company, with capacitors up to 20 per cent of peak load; Public Service Company of Northern Illinois—10%; Public Service Electric and Gas Company—16%; Illinois Power Company—18%. Why not use capacitors as an economic tool in your system planning?

GENERAL ELECTRIC

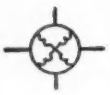
407-112-5700

Standardized Symbols For Electric Power and Control . . . III

VOLTAGE REGULATORS
Induction Type
(One Line Symbols)

Single phase . . . . .

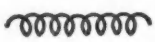
or . . . . .

Three phase . . . . . 

or . . . . .

WINDINGS
(Including inductors, fields, reactors, transformers, etc.)

General, fixed . . . . .

or . . . . . 

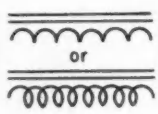
(In any of the adaptations either of the two fundamental symbols may be used)

Adjustable by Fixed Taps with Leads . . .

with Terminals . .

Adjustable Tap or Slide Wire . . . . .

Continuously Adjustable . . . . .

Note: When it is desired especially to distinguish magnetic core inductors, lines parallel to the axis of the scallops or loops should be used . . . . . 

WIRING
Electric Conductor . . . . .

(Distinction between power and control circuits, including device symbols, may be made by using heavy and light lines respectively)

Conductors Underground or in Conduit . . . . .

Future Conductors . . . . .

Spliced Conductors . . . . .

Incoming Lines . . . . .

Outgoing Lines . . . . .

Tie Lines . . . . .

Junction of Conductors . . . . .

Wiring Terminal . .
(Potential terminals may be shown as solid circles when necessary to distinguish from current terminals)

Ground . . . . .

Crossing of Conductors

Not Connected .

Connected . . . . .

Joining of Conductors Not Crossing . . . . .

or . . . . .

THESE GRAPHICAL SYMBOLS are a conclusion to lists in ELECTRICAL WORLD, January 18, 1947, page 172 and February 1, 1947, page 70, to depict frequent items of electric equipment on drawings. Many are basic and general symbols and others are adaptations. The items are a selection from the complete approved list in publication Z32.3—1946 of American Standards Association.

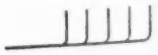
Cable Termination . . . . .

Conduit or Grouping of Leads . . . . .

or . . . . .

or . . . . .

or . . . . .

or . . . . . 

Conductor with Polarity Mark . . . .

Counterpoise . . . . .

Limiter Applications To Network Systems

JULIAN ROGOFF, Assistant Chief Engineer, Burndy Engineering Co., Inc., New York, N. Y.

FIRST DEVELOPED for use in 120/208-volt underground network systems, the original 220-volt limiter was found unsatisfactory in the 440-volt systems often employed for industrial electrical distribution. The demand for a limiter suitable for potentials up to 600 volts became increasingly apparent with the spread of 440-volt industrial network systems. Development of the 600-volt limiter was outlined in ELECTRICAL WORLD, January 18, 1947, page 168.

A Network Application

A typical application of limiters in the industrial network distribution system is illustrated in Fig. 1. Limiters are used to protect each end of the cable forming the secondary (440-volt) distribution loop. Such protection is provided at every distribution panel, both at transformer locations and load panels. Ordinarily, where all the loads are tapped off at the transformer locations, the cables forming the loop are not depended on to carry any current at all. However, when a transformer has to be disconnected from the network for any reason, the loop cables carry current from the remaining sources to the loads joined to the system at the position of the dead transformer. Since each load has its own protective device (circuit breaker, fuse or limiter), the limiters at the cable ends only function to provide protection for the cable insulation itself and to isolate an electrical fault in the cable loop from the remaining system.

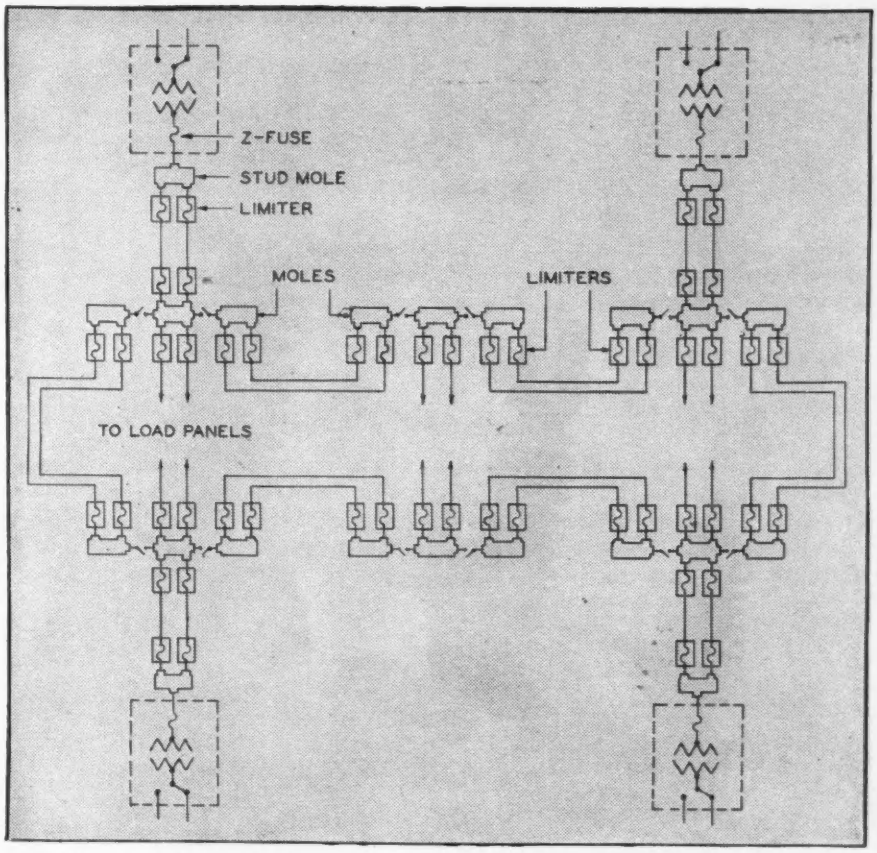


FIG. 1—Typical applications of limiters in an industrial network system

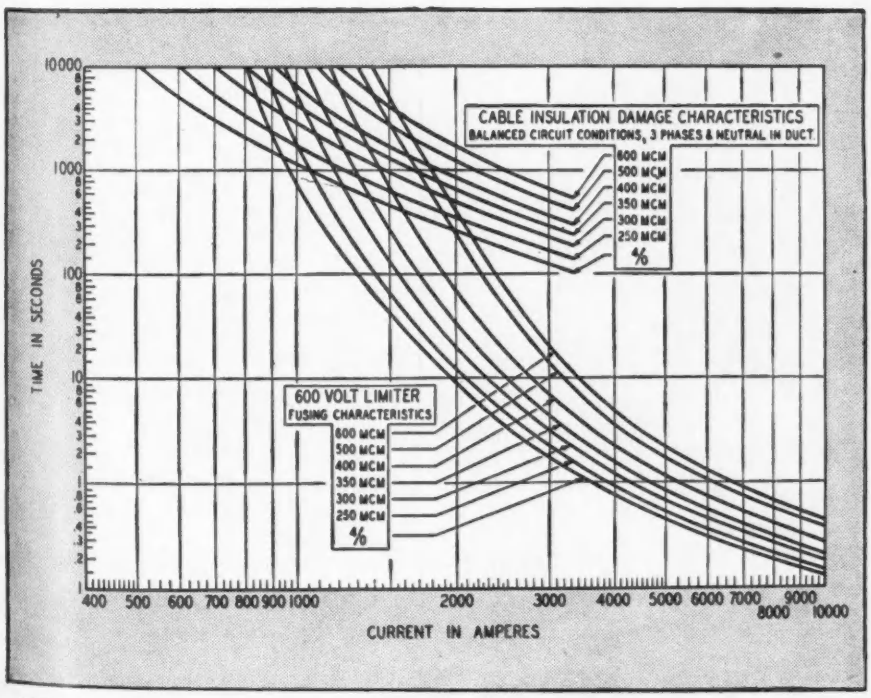


FIG. 2—Time-current characteristics for 600-volt limiters

Interrupting Feature

In order to interrupt effectively the currents which may be available in an electrical system of the type illustrated, the limiter must be capable of interrupting up to 50,000 amp. with no external disturbance whatsoever. The device must be compact and convenient to connect to cable or busbar. One type of limiter is provided with cable sockets at each

TYPE "439" OIL-BLAST

NEW

Interrupting time as low as 3 cycles . . . 20-cycle reclosing . . . Interrupting ratings up to 3500 mva . . . Voltage ratings 115 to 230 kv

BREAKERS

FROM TOP TO BOTTOM

The FK-439 is the latest development in a long line of G-E heavy-duty outdoor breakers. Besides interrupting time of either 5 or 3 cycles (with 20-cycle reclosing), this new unit also brings you many outstanding design features including—

1 COMPLETELY SEALED BUSHINGS

Maintenance is reduced to an absolute minimum by having the bushings completely sealed from the atmosphere. Compact design with the porcelain parts held in compression assures reliability and strength. A magnetic-type oil-level indicator is easily visible from the ground. Experience with over 80,000 moderate-voltage sealed bushings gave General Electric the proper background for developing these completely sealed bushings for high voltages.

2 SIMPLIFIED INTERRUPTER

Light weight and simplified construction of the multi-break interrupter assures faster circuit interruption for greater system stability. Improved performance characteristics have been thoroughly proved by extensive field tests. Contact maintenance problems are almost negligible because of arc-resisting contact materials.

3 SELF-CONTAINED AIR MECHANISM

High-speed reclosing is accomplished by the smooth, positive action of the pneumatic mechanism. This type of apparatus, with a background of eight years operating experience, is completely self-contained. Pneumatic operation means lower control power requirements resulting in smaller batteries and control leads. Electrical and pneumatic controls are readily accessible through the three hinged doors of the mechanism housing.

4 IMPROVED TANK CONSTRUCTION

Sturdy leg-type tank supports facilitate inspection and painting under the tank, permit a reduction in the size of foundation pads. Large side manhole openings provide convenient accessibility to the interior of the tank. This not only permits ready inspection of the interrupters but also easy removal of bushing current transformers. New design features throughout the breaker have resulted in a reduction in tank dimensions and overall unit weight.

Your G-E sales representative has detailed information on the Type FK-439 breaker. ***Apparatus Department, General Electric Company, Schenectady 5, N. Y.***

GENERAL ELECTRIC

869-6-7400

end, which may be indented onto the cable ends by means of a portable hydraulic tool such as the Burndy Hypress. Other limiters are suitable for bolting to busbar on both ends.

•

Radar Detects Approaching Storms

ARMY Air Forces at Andrews Field (Washington, D. C.) now have the benefit of an AN/APQ-13A radar set (10,000 mc.) which gives prompt information about storm conditions within a 250-300 mile radius. The apparatus picks up direction, movement and height of cumulonimbus clouds, intensity of rain showers, precipitation connected with fronts, and is capable of determining within five minutes the weather change to prevail at its present station.

Has Many Uses

Purposes are to protect aircraft in flight surrounding the area of thunderstorms and showers, to show locations of meteorological disturbances which may close airfields in the vicinity, to give advance warning of approaching thunderstorms, so that precautionary measures can be taken to avoid damage by strong winds to aircraft on the flight line, and to provide additional weather data for the use of forecasters.

The plan position indicator (PPI), is the type scope used on the radar set. An imaginary ellipse is described surrounding the area. The range and azimuth of each end of the longitudinal axis of the ellipse are reported in miles and degrees, followed by the width of the ellipse. The intensity is reported by the intensity of radio energy received as an echo from the source of precipitation. Next, the character is described by the arrangements of the echoes; singular, in group form, or scattered. The height of the highest echo, and direction toward which the echoes within the ellipse are moving are then reported. The speed at which the echo sources within the ellipse are moving, the tendency of the echoes, whether growing or disappearing, are indicated by changes in area or intensity.

•

Calibrated Synchroscope Predicts Power Flow

W. G. PARMENTER
Supt. of Substation Construction and Maintenance
Georgia Power & Light Co.,
Valdosta

A SIMPLE, yet quite accurate, method has been devised to predict the amount and direction of the power which will flow through a transmission loop tie line when it is closed. This prediction is made by means of a megawatt scale added to a synchroscope (Fig. 1).

The tie line in question is a 66-kv. line between two 110-kv. systems which are normally held in synchronism by several 110-kv. lines (Fig. 2). Under certain conditions, the oil circuit-breaker must be opened, to prevent overloading the transformer bank which connects the line to System A. It is desirable, however, to close the breaker again as soon as it can be done without overloading the bank.

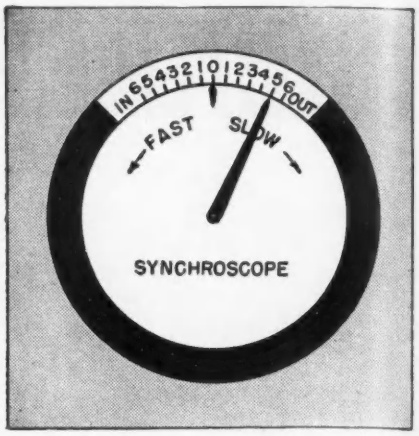


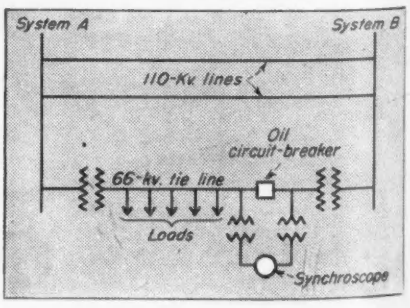
FIG. 1—Megawatt scale calibrated on synchroscope indicates power magnitude to be expected on switch closure

Eliminates Guesswork

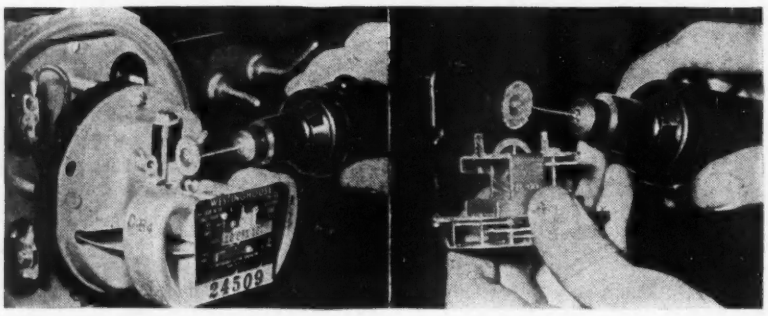
To determine at any time whether or not closing the breaker will produce an undesirable flow of power, the operator needs only to turn on the synchroscope and read the indication on its megawatt scale. By checking at short intervals, he can determine almost the earliest moment at which the breaker can be closed, and needs no longer depend upon experience or guesswork.

The principle of the calibrated synchroscope is that the amount and direction of power flow after the breaker is closed is largely dependent on the phase difference between the voltages on both sides of the breaker when it is open. The zero point of the scale was fixed by mark-

FIG. 2—Calibrated synchroscope applied to protect transformer from overloading on 3-circuit parallel

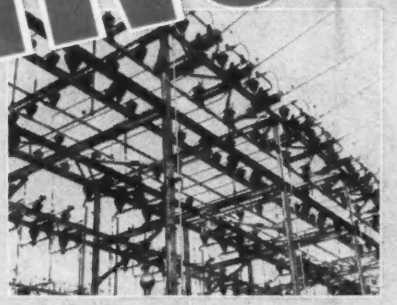


Brush Cleans Meter Gears

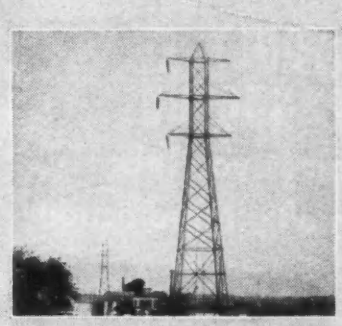


THIS MOTOR TOOL with brush has been found almost indispensable for cleaning meter gears and worms by H. D. Noren, of Coast Counties Gas & Electric Co., Santa Cruz, Calif. The tool hangs conveniently on a hook at the right hand end of the meter shop test board

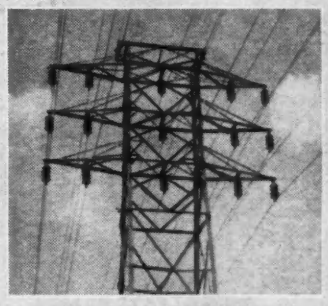
CENTURY OF O-B INSULATORS



These station insulators, and thousands like them, have passed their first quarter-century in several substations on the system and are still as good as new. This is why O-B station insulators remain first choice.

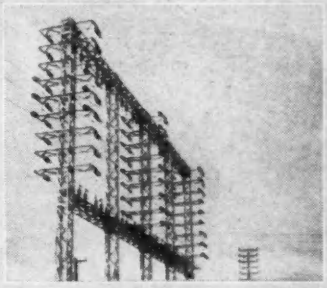


Tieing the system to another major property 35 miles away, this 138-Kv. line has operated with O-B suspension insulators and hardware since 1919 --28 years--with a high record of reliable performance.



Four of these five 24-Kv. circuits are 23 years old. The fifth was built during the war. Performance of the original circuits was the best reason for selecting O-B insulators, again, for the newer line.

-- AND HERE ARE A FEW EXPERIENCES ON THE SAME PROPERTY LEADING TO THIS CHOICE



This dead-end structure handles eight 24-Kv. circuits, four of which join two substations which carry a heavy industrial load for the system. O-B insulators and hardware have served on these lines for the past 20 years.

2744-H

Ohio Brass

MANSFIELD, OHIO

Canadian Ohio Brass Company, Limited
Niagara Falls, - - - Ontario

HEADQUARTERS FOR PORCELAIN INSULATION

Now—an extinguisher with ALL FIVE fire-fighting essentials!

1. EASE
One-hand operation, from bracket to fire. Randolph "4" means panic-proof protection
2. SPEED
Tests prove Randolph "10" stops 2-gallon gasoline fire in 10 seconds
3. SAFETY
Randolph CO_2 will not conduct electricity And it's non-toxic . . . no poisonous fumes
4. NEATNESS
No mess or stain ... no water or chemical damage with Randolph CO_2
5. EFFICIENCY
Randolph is ready for action under all temperatures. No freezing or deterioration
Randolph 4
TO OPERATE
1
2
3

ONLY RANDOLPH gives you this multiple protection

Lacking any one of these fire-fighting essentials, your extinguishers cannot give you full protection. They may actually increase fire-damage in several ways:

For example, a water-filled extinguisher played on an electrical fire may bring serious electrical shock to the employee using the unit. Again, a complicated, cumbersome extinguisher often confuses and panics the operator . . . causes fatal delay during those first few important moments.

Only in a Randolph do you get the complete all-five combination of fire-fighting essentials. Patented trigger-touch affords ONE-HAND action for ease and speed. Dry, odorless carbon dioxide works with split-second speed, disappears with the fire, will not freeze in cold weather.

Approved by Underwriters' Laboratories.

Randolph Laboratories

8 E. Kinzie Street, Chicago 11, Illinois

SEND FOR NEW FREE DATA GUIDE

Analyze your fire protection needs with this compact slide-rule data guide.

NAME_____

FIRM_____

STREET_____

CITY_____ STATE_____

ing the position of the pointer with the breaker closed. Several up-scale points were determined by marking the position of the pointer just before closing the breaker and reading the wattmeter immediately afterward; other points were obtained by reading the wattmeter before opening and marking the scale afterward. The final scale, which represents the average of several trials, is accurate within 500 kilowatts.

The surprising consistency of the calibrated synchroscope suggests that a relay responsive to the phase difference between two voltages could be used, in conjunction with a synchonism relay, to close the breaker automatically whenever system conditions became favorable.

•

Instructions for Working On Energized Lines

FOLLOWING INSTRUCTIONS are an adaptation from the safety rules of Portland (Ore.) General Electric Co.

On lines operated at 750 and up to 7,500 volts, only qualified workmen shall work on energized wires or equipment, and work shall always be done with full use of suitable protective devices and observance of the safety rules.

Handle With Care

Protective devices, rubber gloves, pigs, rubber blankets, hose, hot sticks, etc., when being taken up and lowered from the pole or other location shall be raised or lowered with a hand line. They must not be thrown to the workmen or dropped to the ground from the pole top.

Whenever possible all work should be performed from a position below the energized wires being worked upon. To prevent the possibility of a workman over-reaching and accidently contacting an energized wire, a person shall never throw anything to anyone who is working near energized equipment.

Linemen working beyond energized wires (either over or under) on other wires shall cover all wires between themselves and the wires to be worked on with approved pigs, hose or rubber blankets before they start to work.

They shall wear rubber gloves while applying and removing the protective

THESE FACTS SHOW *Why* . . .

G-E *Thermoplastic* BUILDING WIRE

answers your wiring needs

New Wiring · Rewiring
Maintenance Wiring

Description . . . G-E thermoplastic building wire (Types T and TW) is a small diameter wire made of highest quality materials and produced to meet rigid specifications. It can be used for all wiring requirements where permitted by local codes and is suited for widely varying service conditions.

Physical Properties . . . G-E thermoplastic building wire resists oils, acids, alkalies, and other chemicals and solvents. It is virtually unaffected by sunlight, moisture and weathering. It resists flame and will not support combustion.

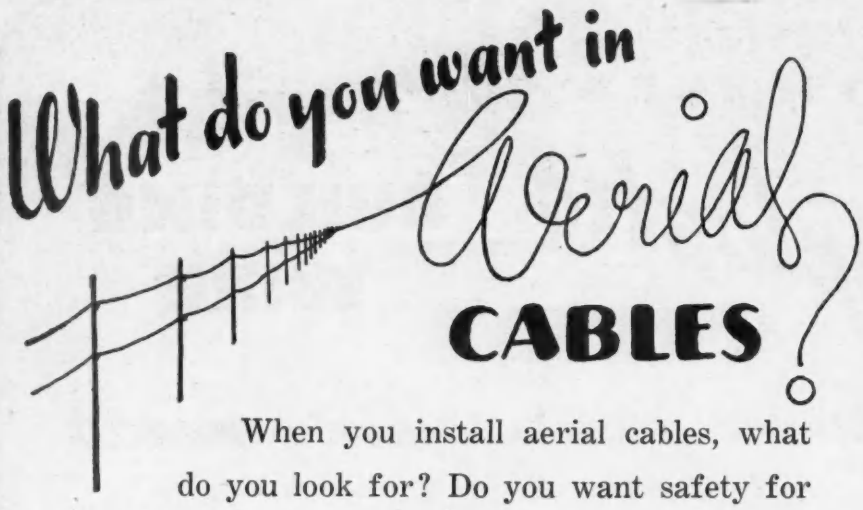
Electrical . . . G-E thermoplastic building wire is high in dielectric strength and will withstand a 720-volt per mil breakdown voltage. Current carrying capacity ranges from 18 amperes for size 14, to 455 amperes for 1000000 CM (based on National Electric Code). High insulation resistance eliminates the danger of loss of power due to current leakage. Types T and TW wires can be used wherever Types R, RL, and RW are acceptable.

Insulation . . . G-E thermoplastic building wire is insulated with plasticized polyvinyl chloride compounds which give it unusual resistance to aging, abrasion, and extremes of temperature. The insulation has a hard, smooth finish.

Types . . . Types T and TW building wires are suitable for new wiring, rewiring, maintenance wiring, and special wiring. Type T is recommended where general-purpose wiring is suitable. Type TW is recommended for service in permanently wet locations.

Information . . . Ask your nearest G-E Merchandise Distributor or write to Section W3-227 for additional data on physical and chemical characteristics, sizes, typical applications, etc. General Electric Company, Appliance and Merchandise Department, Bridgeport 2, Connecticut.

GENERAL ELECTRIC



When you install aerial cables, what do you look for? Do you want safety for your men and for the public? You get it with Simplex Self-Supporting Aerial Cable because it is properly engineered and carefully insulated.

Do you want to build a high voltage line right through thickly settled areas? You can because of the careful engineering and the high-grade insulation on Simplex Cables.

Are you short of line hardware, pins, insulators, cross-arms, braces, rings, and bolts? You needn't trouble your head about them because you need only a small fraction of the usual amount when you install Simplex Self-Supporting Aerial Cables. In short, Simplex Self-Supporting Aerial Cables will solve many pressing problems for you and help to keep your expansion expenses down to a minimum.

If you want further information we will be glad to send you a copy of Data Sheet #117, or the nearest Simplex Branch Office will be glad to help you.

Simplex-WIRES & CABLES

SIMPLEX WIRE & CABLE CO. 79 SIDNEY ST. CAMBRIDGE 39, MASS.

appliances. After the devices are placed they shall continue to wear rubber gloves to provide themselves with double insulation while performing the work.

The above rules are made on the assumption that the wires in question are energized or possibly some of them energized and one grounded. If a grounded wire be present, it shall be treated as though energized.

If the wires referred to are deenergized before and while the work is being performed, the protective devices are not necessary, provided the wires are shorted and grounded to protect the workmen against the possibility of some one energizing them by mistake or accident.

Other Precautions

Extreme care shall be used when working on or around power telephone lines or equipment as these are energized lines.

Hand lines and their fittings shall be of sufficient strength to lower a man in an emergency and one shall always be available on the pole when working on energized lines.

When working on energized lines operated at voltages in excess of 7,500 volts, between conductors, workmen shall use only approved tools of the hot-stick variety.

Workmen shall not approach or take any conducting material, within the distances named below, from any exposed part energized at a potential exceeding 7,500 volts.

Clearance from energized parts is given below:

Operating Voltage	Distance, Ft.
7,500 to 15,000	1
15,000 to 50,000	2
50,000 to 75,000	3
75,000 to 125,000	5
125,000 to 250,000	8
250,000 and over	13

•

Large Timbers Glued By High Frequency

WHERE large quantities of large laminated timbers are to be built, high-frequency dielectric heating offers an opportunity to save much time in setting the glue points. With equipment of the proper size the internal temperature can be increased in minutes instead of hours. And should subsequent heating in a kiln be required the duration of such pe-

Full Capacity Always . . . No Low Cells

In control batteries the name **Floté** *stands for the improved construction expressly developed by Philco engineers for full float service. The advantages of this modern construction are many: measurably lower operating cost, less maintenance, longer battery life—*[illegible] *the elimination of low cells.*

Philco Floté Batteries are available in all types for the special needs of utility engineers. Write for specification data.

PHILCO

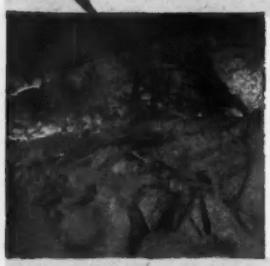
STORAGE BATTERIES

PHILCO CORPORATION • STORAGE BATTERY DIVISION • TRENTON 7, NEW JERSEY

INDUSTRY BANS RUST AND CORROSION *with* Everlasting Fastenings

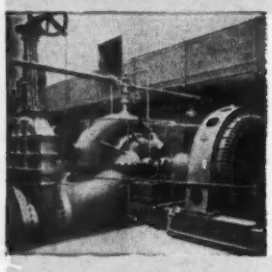
Few industries can escape the destructive effects of rust and corrosion but *all* industries can reduce their costly ravages in maintenance and breakdown.

Here are five industrial applications where Harper's EVERLASTING FASTENINGS have licked rust and corrosion.



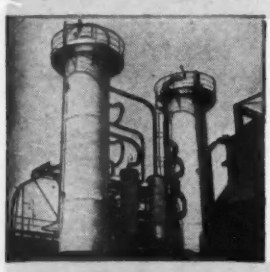
MONEL STOPS CORROSIVE CHEMICALS

Problems in salt production have been solved by using Monel bolts. In mining, treating and handling of many chemicals, non-ferrous alloys are the answer to efficient operation.



BRASS GUARDS WATER SYSTEMS

In valves and pumps that compose the heart of water works, Brass fastenings help in eliminating the most common cause of replacement—rust.

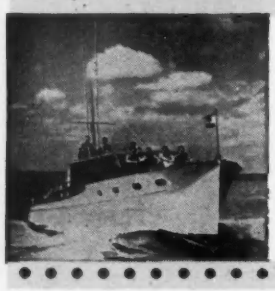


STAINLESS STEEL SOLVES OIL PROBLEMS

Acids and gases at high temperatures attack metal but Stainless Steel alloys cut refinery replacements to a minimum, assure years of continued operation.

UTILITIES CHOOSE SILICON BRONZE

Weather is the bug-a-boo in power lines and other utility applications. Silicon Bronze Bolts reduce season "cracking" and maintenance costs.



NAVAL BRONZE WINS ON SEA

Marine applications demand high strength plus resistance to salt air and water. Naval Bronze fastenings have proved their dependability in marine diesels and ship fittings.

Call upon Harper to solve your fastening problems in your industry.

THE H. M. HARPER COMPANY
2611 Fletcher Street, Chicago 18, Ill.
Branch Offices: New York City, Philadelphia, Los Angeles, Milwaukee, Cincinnati, Dallas
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HARPER
Everlasting Fastenings
Chicago

riods will be greatly reduced compared with kiln heating alone.

Other conclusions presented in a paper* by Dunlap and Bell of the Forest Products Laboratory (Madison, Wis.) at the recent A.S.M.E. annual meeting in New York were that glues already available might be used successfully for marine service to join white oak laminations if precautions are taken to be sure that the sides of the timbers are sufficiently heated. Otherwise it would seem desirable to use a period of supplementary heating in which an ambient temperature is maintained that would include the curing range of the adhesive used. During this time temperatures within the timber would equalize and it seems reasonable that durable joints could be obtained. Since resin glues do not in all cases reach full strength during a short heating period the timber should be maintained under pressure until the glue is well cured.

Thermocouple studies were conconducted on ¾ by 6 by 24-in. white oak with resorcinal formaldehyde resin mixed 100 parts of liquid resin to 25 parts of liquid formaldehyde catalyst. The high-frequency generator was rated 7.5 kw. and was operated at 15 mc. The high-frequency field was applied until the central section reached a temperature of approximately 200 F.

Side Heating Desirable

It was found that where there was a considerable amount of squeeze-out of glue, higher side temperatures resulted. This seemed to be a desirable condition and led to experiments in which wet blotters were placed along side the timber between it and the fiber board insulation. When the electric field was applied the energy was concentrated in the wet blotters causing the water to boil and high side temperatures to be produced. When a less intense electric field was applied, the side heating extended over a longer time and the effect of the heating was carried further into the interior of the timbers that were being heated.

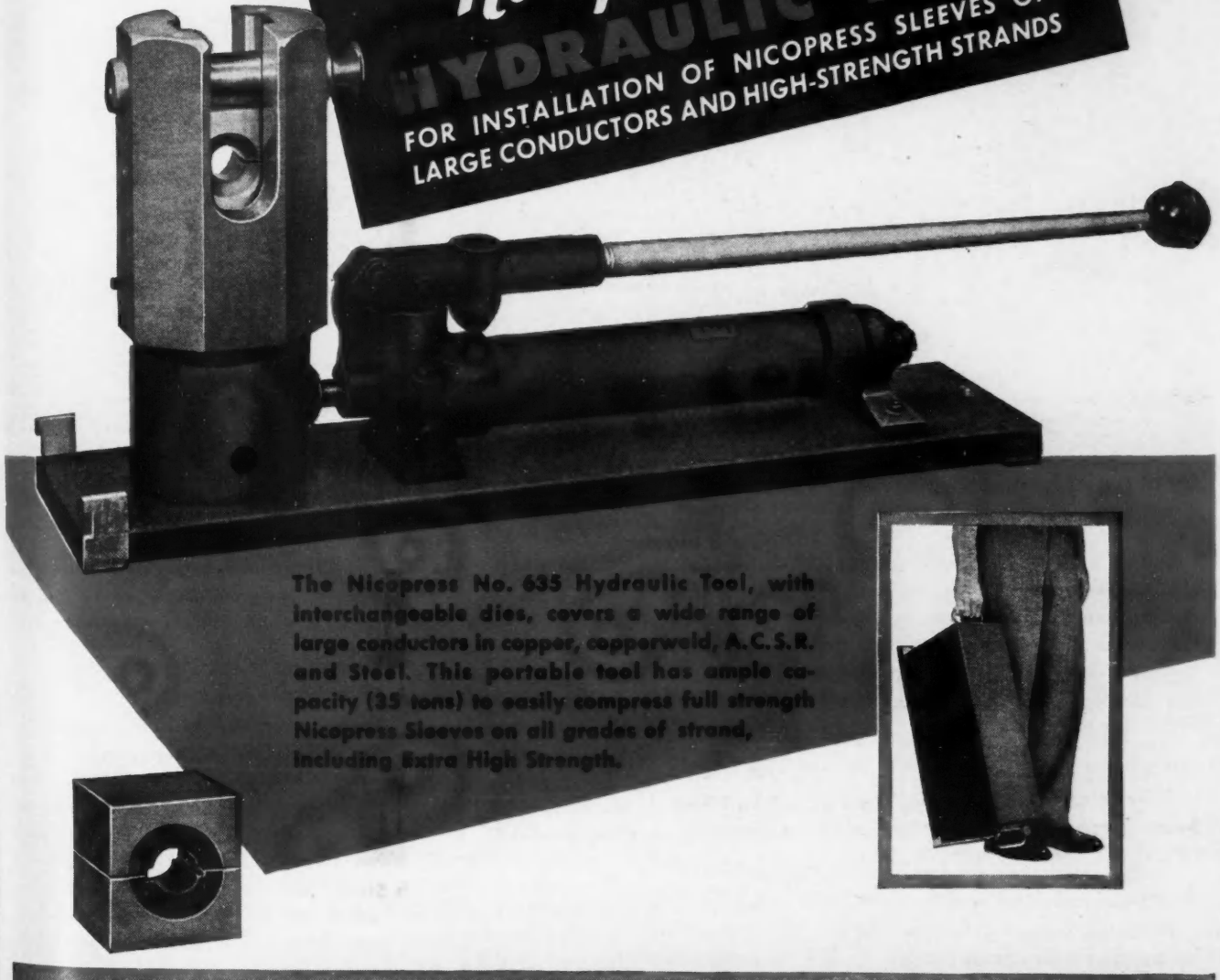
It might be expected that heating timbers in this way would effect more complete cures of the adhesive along the edges of the beam and more durable timbers.

* "Temperature Distribution in White Oak Laminated Timbers Heated In A High-Frequency Electric Field."

SLEEVES for LARGE CONDUCTOR & STATIC WIRE SPLICING

Nicopress No. 635 HYDRAULIC TOOL

FOR INSTALLATION OF NICOPRESS SLEEVES ON LARGE CONDUCTORS AND HIGH-STRENGTH STRANDS



The Nicopress No. 635 Hydraulic Tool, with interchangeable dies, covers a wide range of large conductors in copper, copperweld, A.C.S.R. and Steel. This portable tool has ample capacity (35 tons) to easily compress full strength Nicopress Sleeves on all grades of strand, including Extra High Strength.

Telephone Supply Company

CLEVELAND 3, OHIO

Export Distributor: INTERNATIONAL STANDARD ELECTRIC CORP., NEW YORK, N.Y.

LOAD BUILDING

Seattle City Light Answers House Heating Questions

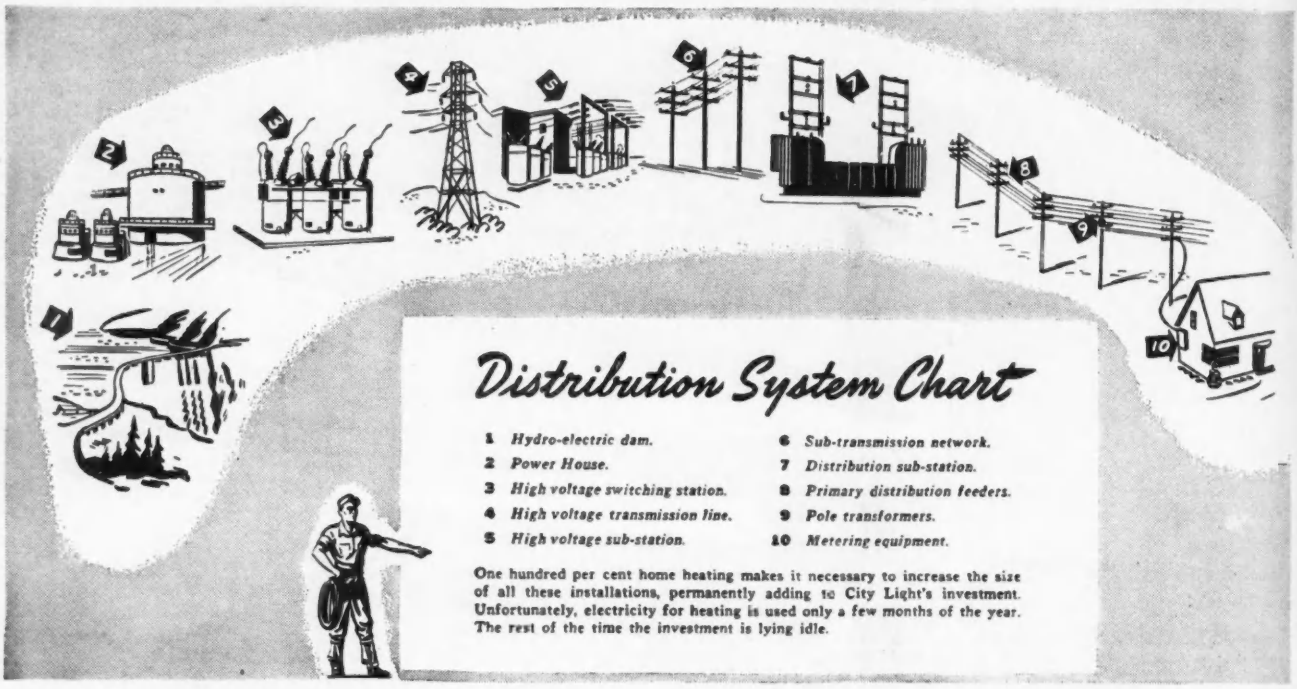

Distribution System Chart
1 Hydro-electric dam.
2 Power House.
3 High voltage switching station.
4 High voltage transmission line.
5 High voltage sub-station.
6 Sub-transmission network.
7 Distribution sub-station.
8 Primary distribution feeders.
9 Pole transformers.
10 Metering equipment.
One hundred per cent home heating makes it necessary to increase the size of all these installations, permanently adding to City Light's investment. Unfortunately, electricity for heating is used only a few months of the year. The rest of the time the investment is lying idle.

CHART used to show that investment in all the elements of a utility system are affected by adding house heating load

IN AN EFFORT to clarify its position on electric house heating and to answer some of the obvious questions that arise in the public's mind, the Seattle City Light municipal system has issued a pamphlet, from which the following are excerpts:

Question:

Why must the rate for electric home heating be higher than other rates?

Answer:

Because electric power for home heating is used in quantity only three months of the year. During the other nine months City Light maintains the service, ready at the flip of a switch, but does not get much revenue for it. City Light's expense, however, continues.

Look at it this way. Could you afford to lease your house to someone who lived in it only three months a year and paid rent for only three months, letting it stand idle the rest of the time?

It is true that you can cook, heat water, light and refrigerate with electricity cheaper than any other way. This is because you use it every day of the year.

Question:

Will heating my home 100 *percent electrically save me money?*

Answer:

No. It will cost you more. When a 100 percent electrical heating rate is established the cost will be undoubtedly high.

Electricity at present is a premium fuel and will not compete on a cost basis with other fuels commonly used in this area except in very unusual cases where the present method is extremely inefficient and wasteful.

Question:

If I install 100 *percent electric heating in my home now under the regular residential rate, is my rate for electric heating likely to be increased soon?*

Answer:

Yes. As has been explained, the residence rate was not intended for house heating. The rate is exceedingly low and is based on year-around use. The City will establish an electric home heating rate for those persons who want the convenience of 100 percent electric heat and who are willing to pay a premium for that convenience.

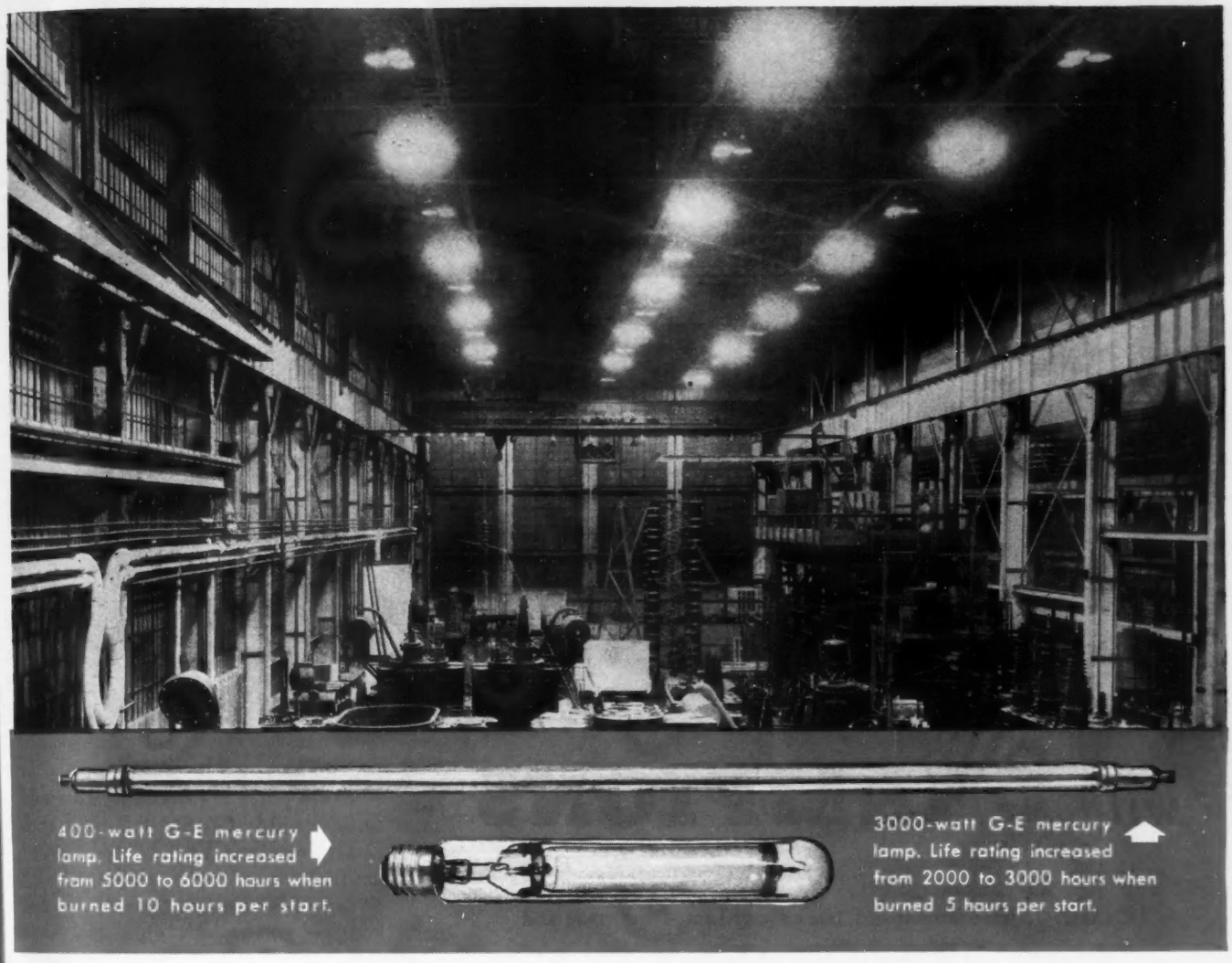
Question:

About how much would it cost me to heat my home 100 *percent electrically under City Light rates?*

Answer:

It is impossible to answer this question with any degree of accuracy. The size of a home, type of construc-

In this large assembly shop, 3000-watt mercury units are combined with three 1000-watt filament lamps to approximate daylight.



400-watt G-E mercury lamp. Life rating increased from 5000 to 6000 hours when burned 10 hours per start.

3000-watt G-E mercury lamp. Life rating increased from 2000 to 3000 hours when burned 5 hours per start.

Now . . . 1000 Hours more life for G-E Mercury Lamps!

Now even greater improvements in industrial lighting are possible with General Electric mercury lamps. The 1000-hour increase in life ratings for both the 400-watt and 3000-watt lamps means a corresponding reduction in lamp renewal costs, with the same dependable illumination.

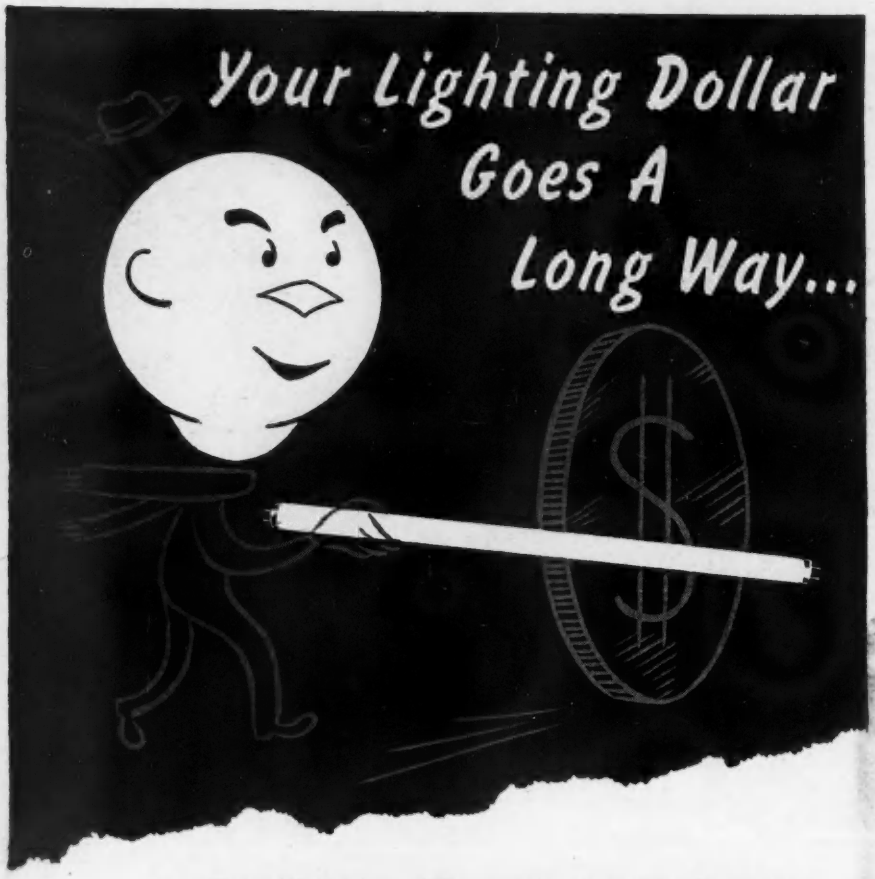
As you plan new industrial lighting jobs—especially those with high mounting in assembly shops, steel mills, foundries, etc.—be sure to make the most of these G-E mercury lamp advantages:

1. **HIGH EFFICIENCY**—Initial light output 40 lumens per lamp watt.
2. **SUSTAINED LIGHT OUTPUT**—Still 35 lumens per lamp watt at 70% of rated life.
3. **LOW MAINTENANCE COST**—High light output per lamp means fewer fixtures to service.
4. **LONG LIFE**—Up to 6000 hours rated life, depending upon wattage and number of starts.

Remember—*whatever lamps you need, G-E makes 'em all!* So you can always count on your nearby General Electric Lamp office as a reliable and unbiased source of information when it comes to lamp selection. General Electric Company, Lamp Department, Nela Park, Cleveland 12, Ohio.

G-E LAMPS

GENERAL ELECTRIC

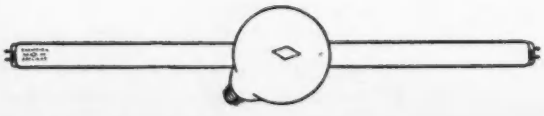


with **CHAMPIONS**

CHAMPION Fluorescent and *Incandescent* Lamps are made and tested to provide the most efficient, low cost industrial light. Back of them is an organization of specialists in industrial lamp manufacture, with trained lighting experts in the field to give you dependable counsel on correct lighting for every part of your plant.

Champion Lamp economy is the result of careful teamwork by a manufacturing and distributing organization set up to get lamps to you at minimum cost. When you standardize on Champion Lamps you can be certain of getting the most lighting and lamps for your money.

May we put you in touch with the Champion distributor in your locality?



CHAMPION LAMP WORKS

Lynn, Massachusetts

A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO

tion, quality of insulation, number of windows, etc., must be considered. The personal habits of different families result in wide difference in fuel consumption for heating. And City Light does not yet know exactly what its heating rate will be.

To give a rough estimate, the cost of heating an average well insulated home 100 percent electrically will probably cost three times as much as combustion fuel.

Question:

Is my present home suitable for 100 percent heating with electricity?

Answer:

Not unless it is of moderate size, adequately insulated and properly wired.

Question:

What would the rate have to be for electricity to make it equal in cost to oil as a source of heat, figured on the basis of heat units (Btu.'s) delivered per dollar?

Answer:

¼ cent per kilowatt-hour. It would be impossible to offer this rate, as it is far less than City Light's cost of delivering power to a customer.

The only time that electricity can compete successfully on a cost basis with other fuels for home heating is when a small amount of heat is needed in certain rooms, such as a bathroom. Then small auxiliary electric heaters can do the job better than a furnace, because the furnace is costly to start for a short period and sends its heat through the entire house.

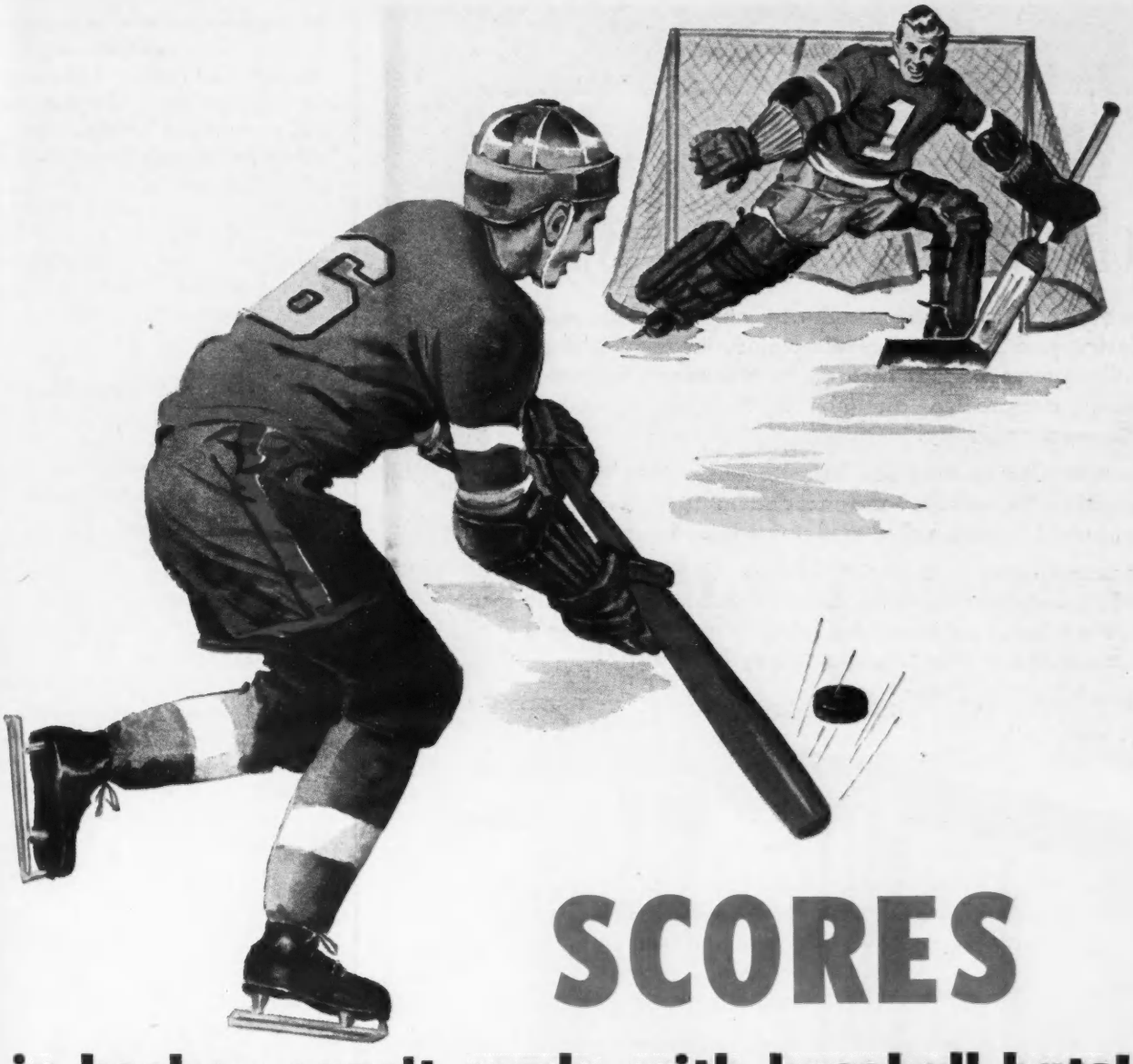
Question:

Is it practical to use electric heat as an auxiliary to installations using other fuels?

Answer:

Yes. Many homes served by City Light have auxiliary electric heaters. They are used principally in the spring, summer and fall whenever a little heat is needed, and the main heating plant is shut down. Such use is very practical and economical, and comes under the regular residential rates.

Auxiliary electric house heating is distinctly different from 100 percent electric house heating. Auxiliary units are comparatively small and



SCORES

in hockey aren't made with baseball bats!

The business of making "home-runs" calls for much different equipment than that with which "goals" are scored.

Even though baseball bats and hockey sticks are both made of wood, they are "engineered" for different objectives. The various physical and chemical characteristics that make MOSINEE papers win in a wide range of highly specialized industrial uses, are also definitely engineered into these essential papers. MOSINEE paper technicians are equipped with scientific laboratory and production controls, plus practical "know how" based on broad experience in creating papers of many characteristics, such as extreme stretch without loss of tensile strength, high absorbency, moisture repellency, controlled pH for desired alkalinity, acidity, or neutral reaction, etc.

* * *

In many industries MOSINEE paper technicians are helping manufacturers and converters to improve products and production. Call MOSINEE.

MOSINEE PAPER MILLS COMPANY

MOSINEE • WISCONSIN

Essential Paper Makers

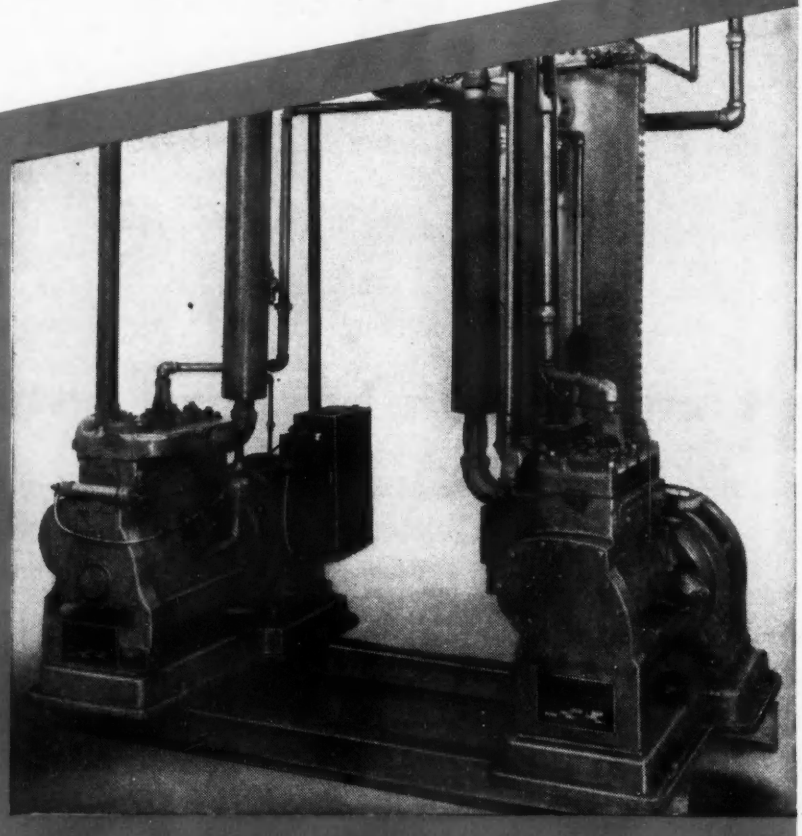
Please address your letter "Attention Dept. B"

Why Industry Uses Schramm Air Compressors

There are many compressed air jobs to be done in Industry, and into this versatile picture fits the Schramm Air Compressor. Either portable or stationary, Schramm enables compressed air jobs to be done quickly—easily—economically!

Schramm Compressors are better because they are 100 per cent watercooled . . . compact and lightweight . . . have mechanical intake valve and forced feed lubrication!

Schramms come in a variety of sizes. So whatever your need for compressed air . . . there's a Schramm to do the job. Write today for illustrated booklets and plan to use a Schramm in the New Era now facing Industry!



SCHRAMM INC.

THE COMPRESSOR PEOPLE

WEST CHESTER, PENNSYLVANIA

do not overload the present system. They are undoubtedly a great convenience as a source of quick heat in the bathroom, rumpus room, nursery, and other places which normally are only intermittently occupied by members of the family.

Question:

Does City Light have surplus power during the winter that could be sold for heating at lower than usual rates?

Answer:

No. City Light is building up its generation and distribution facilities as fast as it can, but has not been able to catch up with the demand. The number of City Light customers continues to increase, and more and more electric ranges and water heaters going on City Light lines. As a result, City Light has been buying power from the Bonneville Power Authority for the last five years. Other utilities in the Northwest are doing the same thing, and now it appears that the Bonneville Power Authority facilities will be hard pressed to meet winter demands.

It Is True . . .

that lighting, cooking, water heating, refrigeration, small appliances and auxiliary heating with two or three thousand watts can be done cheaper by electricity than by any other method.

•

Power Sales Advice In Machine Buying

CONNECTICUT Light & Power Co., Waterbury, recently issued a statement urging industrial customers to consult the utility's power sales staff before contracting with manufacturers for any new or additional electrical equipment. Emphasis was laid upon the importance of knowing about special types of service needed or the expectation of heavy instantaneous demands. Electric power lines in a particular locality may not be suitable for supplying such unusual requirements, and this ounce of prevention may save both customer and company many pounds of cure.

Where electrical equipment has been purchased before ascertaining

when cable runs must "run the gauntlet"

a DELTABESTON* *cable will give extra assurance of uninterrupted power*

Conditions that shorten the life and threaten the performance of regular types of cable are often unavoidable around the power plant. But that's just where the chances of a cable failure *can't* be allowed to rise.

How can you maintain the same safety factor under *extra severe* conditions that you expect from standard power cable under normal conditions? The answer may lie in a DELTABESTON Cable of special construction, like the one shown here. It's one of many developed to "run the gauntlet" of unusual conditions for central stations and power plants.

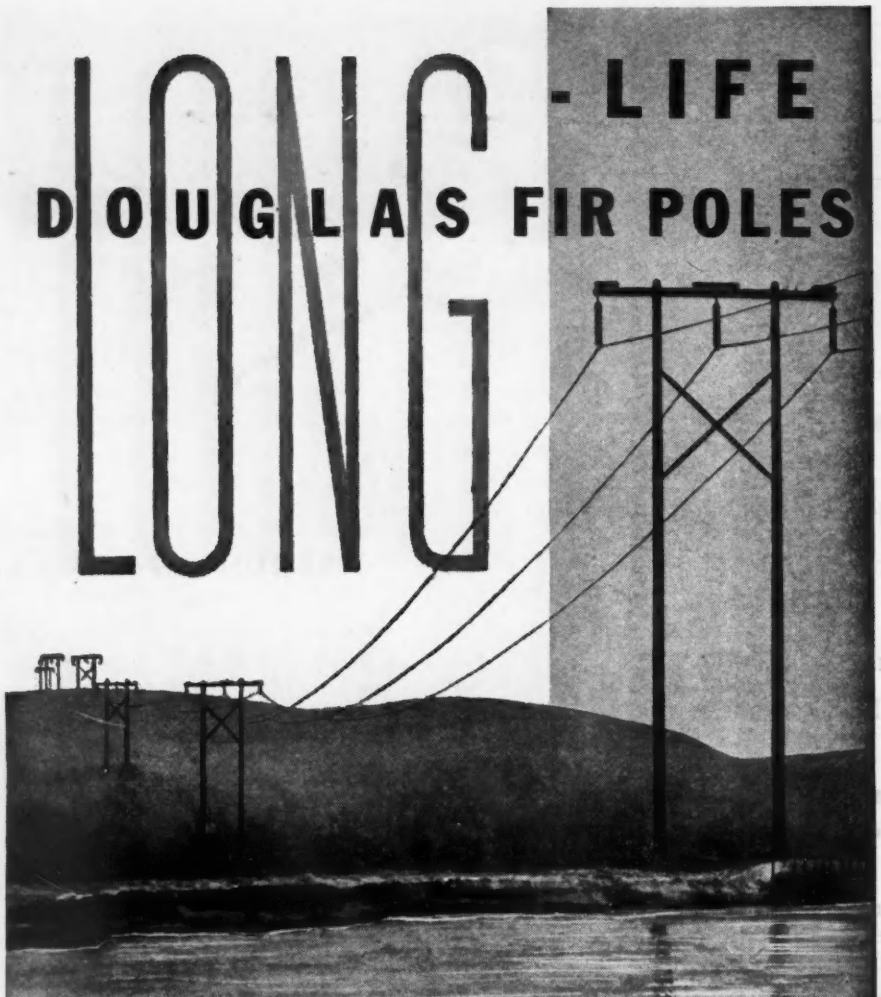
Probably, this particular cable is *not* the one you'll need to meet your combination of conditions. In most cases, one of the regular Deltabeston types will do so. But remember that specialists in heat-resisting cable are always "on call" to select or even develop a Deltabeston construction that will maintain an adequate safety-factor for years to come.

For further information, write Section Y55-218, Appliance and Merchandise Department, General Electric Company, Bridgeport 2, Connecticut. Deltabeston Wires and Cables are distributed by G-E Merchandise Distributors.

* *Trade-mark Reg. U. S. Pat. Off.*

GENERAL ELECTRIC

LONG-LIFE
DOUGLAS FIR POLES



Our specialty is long-length Douglas Fir poles, pressure treated for Long-Life service. Prompt shipments of reasonable quantities can now be made in most lengths from 60 foot to 125 foot. Direct rail shipments out of our treating plant stocks can be made to any point in the United States. Write or wire us your inquiries.

Pressure treated Douglas Fir poles have been for years the standard in pole line construction on the West Coast. Our Long-Life Douglas Fir poles meet ASA Specifications and are pressure treated with coal-tar creosote or creosote-pentachlorphenol solution by the empty cell process, 8-lb. retention, in accordance with AWPA Specifications.

Long-Life Douglas Fir poles, pressure treated from high quality Coast-type timber, will cut your maintenance costs and yield longer and more satisfactory service.

Also Produced by J. H. Baxter & Co. of Oregon—*an associated company*
Plant and Yard—Eugene, Oregon

J. H. Baxter & Co.

333 MONTGOMERY STREET · SAN FRANCISCO 4, CALIFORNIA
LOS ANGELES · LONG BEACH · ALAMEDA · CALIFORNIA, U. S. A.

whether the installation locality has suitable service, it sometimes happens that this makes the equipment inoperative. The company pointed out that reciprocating machinery, such as compressors and pumps, may cause objectionable flickering of lamps in an entire neighborhood or even a town, if the proper operating characteristics are not present. The same is true of many kinds of welding machines of the resistance or transformer type. In a typical case a customer of the C.L.&P. installed a small spot welder without consulting the company. The voltage drop was so great that each time it was operated all of the fluorescent lamps went out. The remedy was a small motor belted to a generator having sufficient inertia to overcome the severe welding bump. The cost of the motor and generator ran so high that the customer stated he would never have installed the welder if he had known this; but as the utility's power sales department was not informed of the proposed purchase in advance, nothing else could be done.

Service Data Needed

The utility also informed its power customers that in some cases motors are ordered without obtaining the characteristics of the energy supply from the company. As a result, motors have to be returned or a long wait undergone before suitable service can be furnished. With the required information the supplier or the manufacturer can give the industrial customer the proper motor for the job. Since the characteristics of service vary somewhat in different localities and neighborhoods, the importance to the customer of following this procedure is not easily exaggerated.

In conclusion the company's statement says:

"We are very anxious to serve any and all types of electrical apparatus. In order to do so to your complete satisfaction we must know the nature of each particular requirement in advance so that proper provisions may be made to handle each situation. Won't you please cooperate with us and keep our industrial power engineer advised before you buy? He is paid to help you. He will be glad to give you data and specifications on electrical machinery, which, if followed, will prevent trouble after an installation is made."

CHANCE (TIPS) HOT TAP CLAMPS
hold tight without sticking -

PERMA-GRIP TAP CLAMPS . . .

Make permanent or temporary hot tap connections that are dependable and economical. They stay put without vibrating loose, and yet they can be readily unscrewed and removed with a Clamp Stick. They are made for tapping to aluminum, copper, or steel conductors and are available in a complete range of sizes to meet all requirements.

Available for immediate shipment.

- HIGH CURRENT CAPACITY
- HIGH MECHANICAL STRENGTH
- HOLD TIGHT WITHOUT STICKING
- THREE POINT CONTACT
- POSITIVE PRESSURE JUMPER CONNECTION
- AVAILABLE IN ALL TYPES AND SIZES

SNAP TAP CLAMPS . . .

Provide both a strong, permanent connection and a rapid "disconnect." The Snap Tap Clamp is applied to the line with a quick snap effect, using any Chance Clamp Stick, and is tightened by turning the eye screw. Available for all types of connections. The jaws of the Snap Tap Clamp will take conductors ranging in size from No. 8 solid copper to 4/0 stranded copper.

Duck bill, compression tap wire terminal, and enclosed thread eye screw are made of high strength bronze. Available for immediate shipment.

GRIP-ALL CLAMP STICK . . .

All taps can be made "hot" when this clamp stick is used in combination with TIPS Clamps. Designed for manipulating all types of eye screw tap clamps and all sizes of grounding clamps, it can also be used for a large variety of other hot line jobs.

The Grip-All Clamp Stick is available with standard or extended jaw. The pole and pull rod are tested to withstand 75,000 volts per foot. The sleeve, made of laminated plastic, has high mechanical and dielectric strength. Metal fittings are aluminum and bronze.

Write for detailed information about these indispensable maintenance tools

C4611

"THERE'S NOTHING TOO GOOD WHERE LIFE IS AT STAKE"

ABC INDUSTRIES

A·B·CHANCE CO·

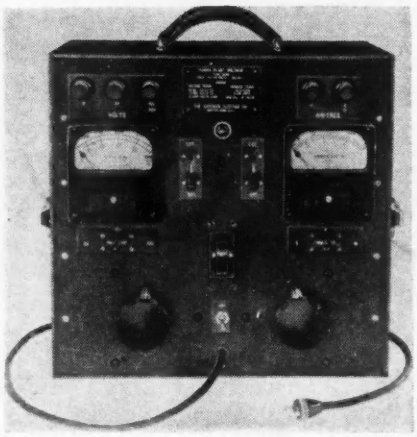
CENTRALIA, MISSOURI • SAN FRANCISCO, CALIFORNIA

NEW EQUIPMENT

Adjustable Test Voltages, Currents from Portable Supply

A NEW PORTABLE a.c. power supply, which offers a portable source of metered, continuously adjustable a.c. voltage and current, has been announced by the Superior Electric Co., 224 Church St., Bristol, Conn. It was designed primarily to meet the needs of utility testmen but is reported to have other diversified applications.

The variable voltage and current feature is achieved by two Powerstat variable transformers operating in conjunction with auxiliary transformers. Voltage and current are varied independently and are electrically isolated from each other. For metering purposes, a triple range voltmeter and a double range ammeter are supplied. When it is required to measure external voltages and currents, these meters can be employed for such purposes by throwing the lever-action switches below each meter. It is designed for use on either 115 or 230-volt, 50 or 60-cycle circuits. The output voltage ranges are 0-30, 0-150, and 0-300 volts



while the current ranges are 0-5 and 0-20 amp. A circuit breaker is inbuilt for instrument protection.

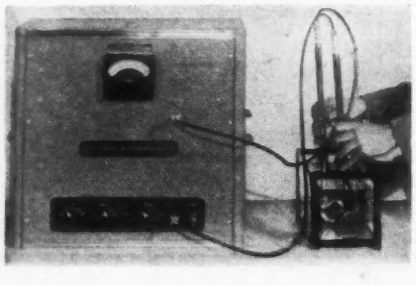
A few of the applications mentioned in the utility field are checking voltmeters, ammeters, watthour meters, starting currents of relays, performance of impedance relays, and checking of bus and instrument voltages.

• • •

Ultrasonic Tester Indicates Voids and Cracks

A NEW ultrasonic materials tester designed to indicate the presence of voids, cracks, porosity, laminations, poor bonds, and other internal flaws in metals, plastics, and ceramics has been introduced by the special products division, General Electric Co., Schenectady, N. Y. The tester is useful in production testing of metal castings, forgings, or finished machined parts as well as plastic or ceramic parts.

The new tester sends a beam of ultrasonic waves through the specimen being tested. Changes in the amount of energy transmitted through the specimen are an indication of the presence and extent of flaws. The tester is portable, self-contained, provides a direct reading and is not affected by small changes in dimensions or position of test pieces, it is reported.



The new instrument consists of a complete wide-band ultrasonic transmitting-receiving system having a high-frequency generator, a crystal transducer for producing ultrasonic vibrations, a satisfactory medium such as water to transmit these vibrations, a second crystal transducer to convert the received mechanical energy into electrical signals, and an indicator supplying information for materials inspection or analysis.

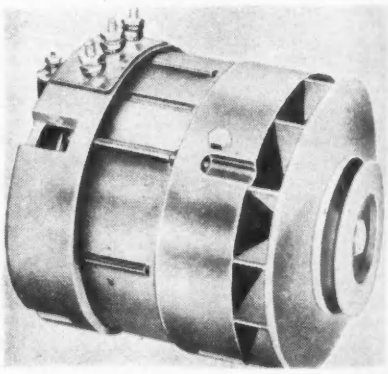
To examine regularly shaped specimens, the two transducers are immersed in a tank containing water, and the specimen is inserted between them. Ultrasonic waves are then sent through the specimen, and the resulting reading on the indicating instrument is compared with that for a specimen shown to be sound by X-ray, mechanical breakage, or sectioning methods. Internal flaws will produce measurable decreases in total transmission of waves through the specimen, and a consequent drop in the instrument reading.

The instrument can also be used to indicate changes of viscosity, compressibility, and density of liquids, when these significantly alter the velocity or attenuation of ultrasonic transmission.

•

Battery Charger Uses A.C. Generator, Rectifier

A NEW generating system design to maintain batteries in trucks and cars equipped with two-way radio, flasher lights, etc., at full charge has been developed by the Leece-Neville Co., Cleveland 14, Ohio. The system consists of



an a.c. generator, a voltage regular, and a rectifier. Chief advantages claimed are that it will deliver from 25 to 35 amp. at engine idle speed and 60 amp. at 15 mph. and maintain this to top speed, that it weighs approximately 60 percent less than comparable d.c. equipment, and that, due to the absence of commutators, radio noise is held to a minimum. It is available for use on 6- and 12-volt circuits.

•

Sheet Plastic Creaser Thermostatically Controlled

AN IMPROVED precision tool, called the Thermocreaser, which provides a thermostatically controlled, instant-crease action for thermoplastic sheeting with repetitive uniformity, has been developed by the Taber Instrument Corp., North Tonawanda, N. Y. The unit pre-

HUBBARD AUTOGAP FUSE CUTOUT

NO. 2315

HUBBARD AUTOGAP FUSE CUTOUT is a combination of No. 2302, 9 KV Autogap Lightning Arrester with a new, improved 7-1/2 KV open type fuse cutout. The assembly is Stock No. 2315.

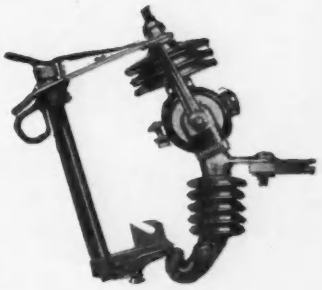
VOLTAGE, phase to ground is recommended to be limited to 7500 Volts.

FUSE rating is 50 Amperes. Fuse links are not furnished. Any standard can be used.

INTERRUPTING CAPACITY of the Hubbard Autogap Fuse Cutout is 1200 Amperes.

MOUNTING Brackets are available. No. 2323 for Crossarm and No. 2325 for pole. Specify type of mounting when ordering.

WEIGHT of the assembly is 18 Pounds each, packed for shipment.



CLOSED POSITION: The flat, phosphor bronze spring at the top is in tension, ready to kick out the mechanism instantly when the blowing of the fuse releases the tension.

OPERATING: This view shows the action during transition from "closed" to "open" positions. The fuse has blown and the toggle mechanism is forced open by the top contact spring. The gap caused by the blown fuse is instantly lengthened to at least 3-inches by the leverage of the toggle mechanism, causing the arc to be extinguished within the fibre fuse tube rather than at the top contacts, where burning might occur.

OPEN POSITION: Top contact spring is relaxed, having exerted its pressure toward opening the mechanism. Tube drops to hanging, open position which places the notch for "hot-stick" removal of fuse tube in an accessible spot.

HUBBARD AND COMPANY

PITTSBURGH · CHICAGO · OAKLAND, CALIF.

SOLDERLESS—TAPELESS

Wire Connectors

SOLAR

SCRU-ITS

"MR. SCRU-IT" Trade Mark

Solar SCRU-ITS are used for connecting two or more wires without tape, solder, flame or tools. They are economical and easy to use—wire ends are stripped and SCRU-ITS screw right on to form a compact and efficient joint.

SCRU-ITS give better mechanical and electrical contact . . . eliminate possibilities of shorts, grounding and corrosion. Their compact size permits their use where working space is at a minimum.

Available in several sizes for connecting various combinations of wires.

EASY TO USE:

1. STRIP WIRE

2. SCREW IT

3. THAT'S IT with SCRU-ITS!

MILLIONS IN USE • HUNDREDS OF APPLICATIONS

"Roughing-in" or permanent wiring is simplified with SCRU-ITS . . . they thread on with a twist of the wrist . . . and the joint is complete!

- Fixtures
- Outlet Boxes
- Fuse Boxes
- Panel Boards
- Switch Boxes
- Lighting Devices
- Conduit Boxes
- Circuit Breakers
- Switch Controls
- Motor Connections

and many others.

U S PATENT NO 1,933,555

DON'T TAPE
DON'T SOLDER
"SCRU-IT"!

• MADE IN FOUR SIZES

• MAY BE USED WITH SOLID OR STRANDED WIRES

Write for Data Sheet A-2

For complete specifications on SCRU-IT sizes, uses, prices, etc., WRITE TODAY.

SOLAR ELECTRIC CORPORATION

FACTORY and SALES OFFICES

WARREN, PENNSYLVANIA

vides a right-angle crease or fold on 5-20 pt. plastic sheet up to 30 in. in width. Creasing is reported placed on a purely productive basis, time depending upon the type and thickness of the sheet stock in fabrication.

Unit is hand fed and foot operated. All exterior surfaces are reported easily kept at "tip-top cleanliness." It operates on 115 or 230 volts, a.c. or d.c., and produces peak efficiency on most materials at a temperature of 240 deg. F.

Operating controls include thermostat to regulate creasing blade temperature, two indicating lights, thermometer for registering blade temperature, and adjustable back gages for correct feeding and creasing of blanked stock.

•

Two New Infrared Industrial Lamps Added to Line

TWO NEW 125-WATT, infrared, industrial lamps have been announced by the Lamp Department, General Electric Co., Nela Park, Cleveland, Ohio. One of the new lamps is equipped with a G-30 bulb, and is designed especially for use in open reflector ovens. It has a medium skirted base, 5-in. light center length, and fits infrared reflectors now in general use. The other new lamp has an R-40 reflector type bulb and a medium skirted base. Average laboratory life for both lamps is rated in excess of 5,000 hours.

With the addition of these two new lamps, the company's industrial infrared lamp line now includes 125-watt, 250-watt, and 375-watt lamps in both the G-30 and R-40 bulb types, and 500-watt and 1,000-watt T-40 type lamps.

Designed to be used interchangeably with the 250-watt and 375-watt G-30 and R-40 lamps, the new models are especially suited to oven applications where it is desired to maintain a given lamp spacing and distribution of radiant energy, but where an even heat is required, or for use on finishes which might be harmed by a greater energy density, the company reports.

NEWS ABOUT PEOPLE

Reliance Electric Elects Harrell Vice-President

Fred E. Harrell, general works manager of the Reliance Electric & Engineering Co., Cleveland, has been elected manufacturing vice-president of the company.

Mr. Harrell joined the Reliance organization in 1924. He was made assistant chief engineer in 1934, served as executive director of the company's marine division plant during the early part of the war, became chief engineer of the company in 1943 and general works manager in 1945. He is active in committee work for the American Institute of Electrical Engineers.

F. E. HARRELL

•

Ford, Bacon & Davis Assign New Executive Duties

Ford, Bacon & Davis, Inc., have announced the election of Everett S. Coldwell as executive vice-president and of David A. Uebelacker as vice-president and director in general charge of new business activities.

After ten years of varied industrial engineering and manufacturing operating experience, Mr. Coldwell joined the staff of Ford, Bacon & Davis, where he has been in charge of industrial and organization work for numerous clients. He has been with the organization since 1926 and a vice-president since 1941. Mr. Coldwell directed the operation of the Arkansas Ordnance plant in Jacksonville, Ark., and certain phases of the Oak Ridge, Tenn., project, both of which activities Ford, Bacon & Davis operated on management contracts. He is a fellow of the American Society of Mechanical Engineers and a registered professional engineer in the states of New York and Illinois.

Bachrach

E. S. COLDWELL

Mr. Uebelacker has been with the organization since 1932. With the War Production Board for two years during World War II, he served as chief of the nickel, copper and zinc branches. He also served for a year with the Lend-Lease Administration and later was sent to London, where for six months he was attached to the staff of the Mission for Economic Affairs. He is the son of the late Charles F. Uebelacker, one of the early partners of Ford, Bacon & Davis.

D. A. UEBELACKER

LeRoy Made Manufacturing Director, RCA Victor Div.

Harry E. LeRoy, formerly general plant manager of the RCA engineering products department, RCA Victor Division, Radio Corp. of America, Camden, N. J., has been appointed to the newly created position of director of manufacturing for that division. In his new position, he will coordinate and direct the manufacturing activities of the company's plants throughout the country.

Arthur Malcarney, formerly plant manager of the parts department, was named to succeed Mr. LeRoy as general plant manager of the engineering products department.

Mr. LeRoy first became associated with RCA in 1923 as an electrician at Harrison. After holding various engineering positions he was named manager of the RCA Victor plant at Indianapolis, the position he held until 1938 when he was appointed executive assistant to the vice-president in charge of engineering in Camden. Subsequently he was made manager of the Camden plant. The outstanding production achievements of the plant under his supervision won for Mr. LeRoy a commendation from the Navy.

H. E. LEROY

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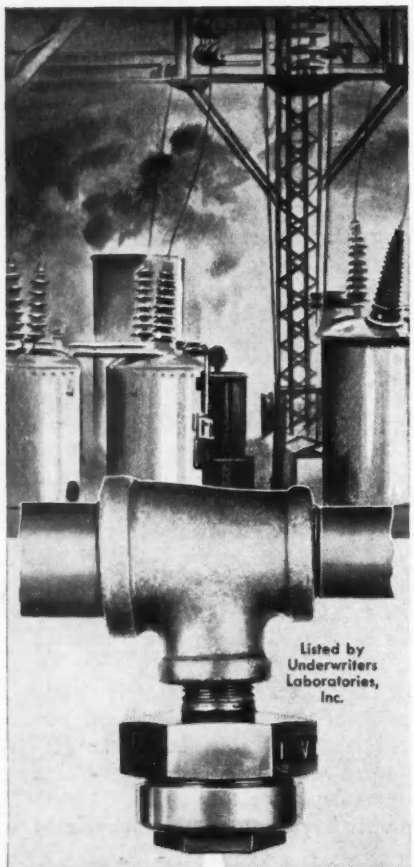
▶ G. MACK WYNN, head of the survey section of the engineering department of Georgia Power Co., has resigned to accept the vice-presidency of the W & A



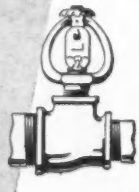
TWO OUT OF THREE CAN BE SAVED

Costly transformer fires are hard to eliminate altogether, but at least two of the three big pots in a bank can be saved.

Blaw-Knox Aquatomic Fog Nozzles installed in fixed sprinkler systems are dependable and effective protection.

They strike to the base of the fire in spite of air turbulence—they cool the burning oil and quench the flames quickly.

Blaw-Knox Aquatomic Fog Nozzles are cut out for the job of protecting power transformers, indoors or out.



Also—

Blaw-Knox offers Standard Wet and Dry Pipe Systems, as well as Thermostatically Controlled Pre-Action and Deluge Systems.

Write for details.

BLAW-KNOX

SPRINKLER DIVISION

829 Beaver Avenue, N.S.,
Pittsburgh 12, Penna.

Manufacturing Co. in Decatur, Ga. Mr. Wynn joined the company in 1921 while he was attending Georgia Tech, from which he was graduated in 1925. He is a native of Jasper, Fla., a member of the Georgia Engineering Society, and a major in the Civil Air Patrol.

•

Federal Electric Products Names New Executives

Two new vice-presidents, W. H. Lantz, Jr., of Hartford, and Rey F. Frenger of St. Louis, have been elected by Fed-

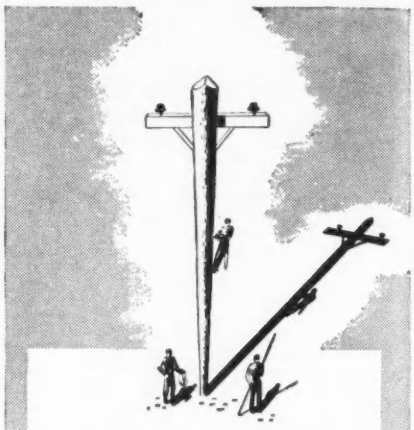
W. H. Lantz, Jr.

eral Electric Products Co., Newark, N. J. Mr. Lantz, who became identified with Federal in 1941, will be the executive head of the Hartford division. Mr. Frenger joined the organization last

R. F. Frenger

year and will be in charge of the Wm. Wurdack division in St. Louis.

Prior to assuming his new position, Mr. Lantz was general manager of the Hartford division. As chief engineer for Federal from 1941 to 1945, he was instrumental in developing numerous electrical control devices. Mr. Lantz was formerly chief design engineer for American Electric Switch Corp. and de-



New Life for OLD POLES as well as NEW ONES

Because Chapman "Penta" Preservative can be applied by spraying, brushing or soaking, it is the ideal treatment for protecting or reclaiming old poles. This is the same material which, applied by conventional pressure treatment, showed superior resistance to decay and termites in a careful 10-year test by the Forest Service, U. S. Department of Agriculture.

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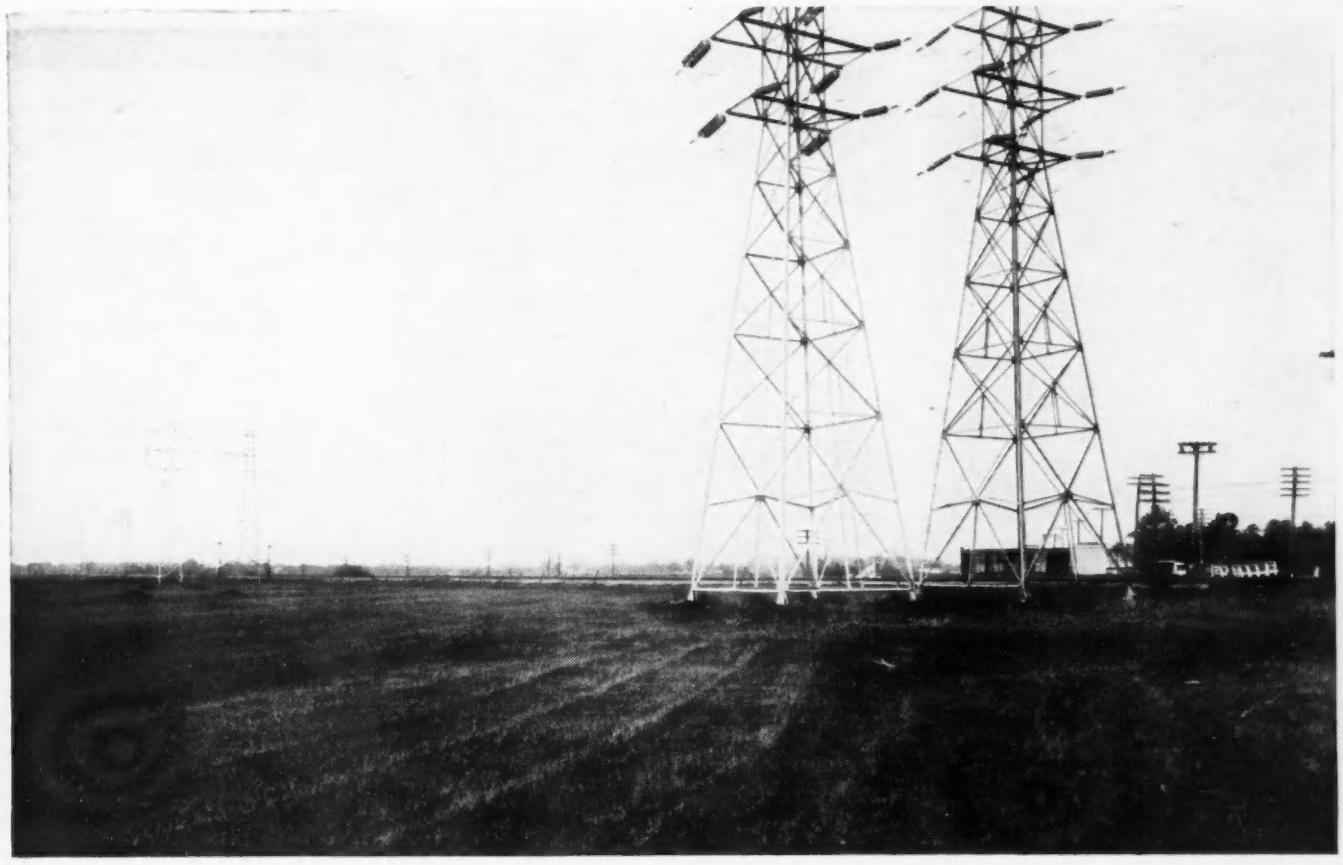
"Penta" Preservative contains *Pentachlorphenol*, a product of *The Dow Chemical Company*

Save money this year on Weed Control!



2-4 Dow Weed Killer

Low cost. Highly recommended for killing broad-leaved weeds in lawns to beautify parks, streets, and company buildings. Available both as a liquid and a powder.

Esteron 44—a powerful 2, 4-D Weed Killer

Especially useful against many types of woody plants, such as wild rose, poison ivy, mesquite and sprouts of many other woody species. Ideal for use on cut-over land along right of way.

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"Chemical Mower" for weeds along canals, ditch banks, fences and roads. Kills most annuals completely. Destroys all weeds and grass above ground, leaves roots to prevent soil erosion.

Now you can destroy weeds by the million—for less money! No more mowing, digging or burning—just spray them with the right Dow Weed Killer—and watch them die! Weed control with chemicals will cut your maintenance costs way down—turn a troublesome, expensive job into a simple, fast-moving one.

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Use Dow Weed Killers this year and you'll never go back to old-fashioned methods! Ask your dealer or write direct.

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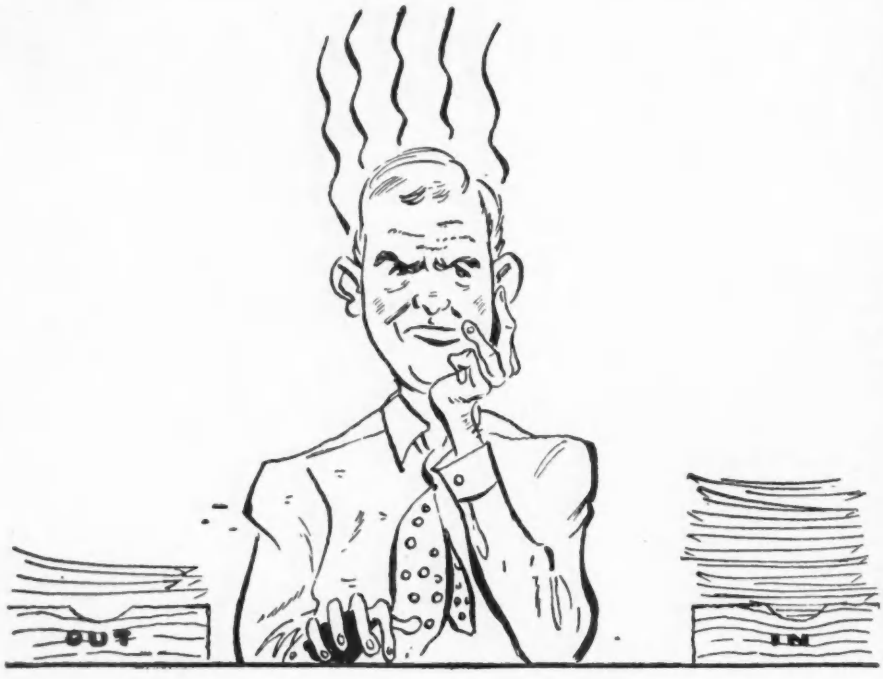

HEADACHES?

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With Super-Trol, you have the finest system for supervisory control yet devised . . . fast, flexible, tailor-made to meet your specific requirements. Installations can be designed to handle any number of units, regardless of location, with complete telemetering and telephone service, all on the same two wire control circuit. The result . . . constant, dependable operation . . . a marked increase in efficiency at a greatly reduced cost.

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sign and project engineer for Wadsworth Electric & Mfg. Co.

Mr. Frenger has had broad experience in the electrical industry, particularly with Westinghouse Electric Corp. where at various stages of his career he was manager of the panelboard department, sales manager of the switchgear division, manager of the micarta division, and manager of the small motor division. Most recently he was assistant to the vice-president of the National Vulcanized Fibre Co., Wilmington, Del.

Announcement of the appointment of A. Richard Fiske as advertising manager of the company was also made. Mr. Fiske goes to Federal Electric from Westinghouse Electric Corp., Lamp Division, Bloomfield, N. J., where from 1940 to 1942 he was head of public relations and publicity and from 1942 to 1946 assistant manager of advertising.

•

Beane Made General Sales Manager of Bristol Co.

Announcement has been made of the appointment of H. E. Beane to the position of general sales manager of The Bristol Co., Waterbury, Conn.

Starting as a sales engineer, Mr. Beane has been associated with The Bristol Co. since 1920. From 1925 to 1935, he was district manager of various branch offices of the company. He was made field sales manager in 1936 and sales manager in 1943.

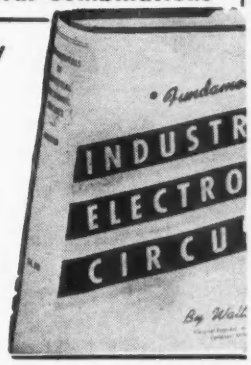
•

► ALAN STEINERT, president of the Eastern Co., Cambridge, Mass., and one of the best known distributors in the New England refrigeration, radio and talking machine fields, has been elected president of the Electric Institute of Boston, Inc., succeeding Frank L. Nason of the Westinghouse Electric Corp. Mr. Steinert has been active in the wholesaling field since 1923. He founded the Eastern Co. in 1933.

► IRVING C. HARRIS has been appointed construction engineer at Shasta Dam. Formerly acting construction engineer at the dam, Mr. Harris is in charge of all work at Shasta and Keswick dams and on the Oroville-Sacramento transmission line. He served as director of power at Boulder Dam, transferring to the Shasta project as senior engineer in 1941.

► JOHN T. KIMBALL, widely known as a business and civic leader in Jackson, Miss., has joined the Central Arizona Light & Power Co., Phoenix. In his new work, he will be associated with Henry B. Sargeant, recently made president of

Explaining the performance of ELECTRON TUBES
in fundamental combinations



Pointing the way to the design, analysis and maintenance of electronic circuits

This book provides both engineers and practical plant men with a clear understanding of the performance of electronic tubes in fundamental combinations with other circuit elements. It demonstrates the basic principles applying to circuits containing vacuum tubes, reducing such circuits to a combination of more familiar circuit elements. The material covers a broad range, from fundamentals of direct current, to auxiliary circuits and equipment for cathode-ray oscilloscopes. Included are such recent combinations as resistance-capacitance tuned oscillators, phase-shift oscillators, and circuits for photoelectric tubes.

Just published! **Fundamentals of**

INDUSTRIAL ELECTRONIC CIRCUITS

By WALTHER RICHTER

Consulting Electrical Engineer, Allis-Chalmers Manufacturing Company

569 pages, 6x9, 397 figures, $4.50

Here is an essentially practical and highly useful presentation of electronic circuits, bridging the gap between the popular, and the rigorous, highly mathematical, treatments. The treatment is complete. It provides enough information to enable you to analyze and design such circuits, yet keeps mathematical requirements to a minimum. Stressing fundamental principles, the book covers the elements of electronic circuits in clearcut detail, emphasizing as well the similarity between these and other electric circuits, so that the reader may tie up this new subject with what he already knows.

Here are a few of the topics covered in the 27 chapters in this book:

- Nonlinear Conductors
- Fundamentals of Rectifier Circuits
- Multigrid Tubes
- Multistage Amplifiers
- Cathode Followers
- Vacuum-tube ac Voltmeters
- Beat-frequency Oscillators
- Multivibrators and Trigger Circuits
- Gaseous Tubes
- Photoelectric Tubes
- Optical Systems, Light Sources and Filters for Photoelectric Tubes
- Cathode-ray Tubes

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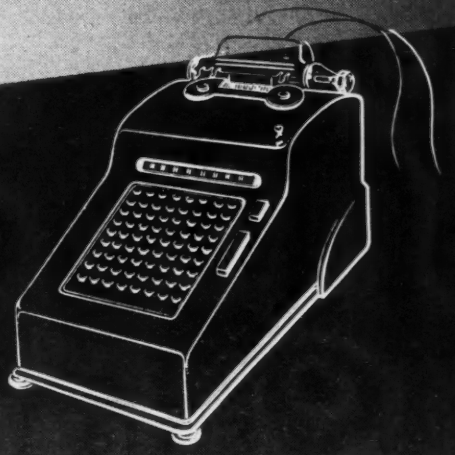
To Hold the Profit Line



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METER SERVICE EQUIPMENT

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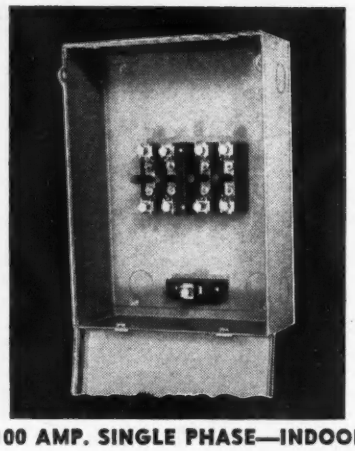

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the Arizona utility. Mr. Kimball's new duties will include industrial development work, a field in which he gathered much experience during the time he was director of the Mississippi agricultural and industrial board.

•

Jasper Blackburn Enlarges Engineering Department

Jasper Blackburn Products Corp., St. Louis, has announced the association with its engineering department of John A. Toedtman, Jr., Clinton M. Hollocher, and Chester Sorflaten.

A mechanical engineer, Mr. Toedtman has served in the Navy for three years and previously was connected with the St. Louis Ordnance District and the Carter Oil Co. Mr. Sorflaten was a distribution design engineer with the Commonwealth Edison Co. of Chicago until the war, when he entered the Navy. Mr. Sorflaten and Mr. Toedtman will devote their full time to product design and improvement. Mr. Hollocher was formerly a design engineer with the Shell Oil Co. until he entered the Army, where he served for four years. He will do industrial engineering in the company's plant.

•

▶ G. S. TIMOSHENKO, formerly associate professor of electrical engineering, University of Connecticut, Storrs, Conn., has been appointed professor and head of the electrical engineering department of the university.

▶ EUGENE S. MATTHEWS has resigned from the State Railroad Commission of Florida. Mr. Matthews' retirement followed approximately 23 years of service on the board.

▶ W. H. BARNWELL, formerly industrial manager for the Georgia Power Co., Atlanta, has become consulting industrial engineer for the Central of Georgia Railway. Mr. Barnwell joined Georgia Power in 1929.

▶ JUSTIN H. AHRENS, formerly technical engineer in the distribution department of the Hartford (Conn.) Electric Light Co., has been appointed safety engineer for the company, a newly created position.

▶ LEWIS AMBROSE has been appointed superintendent of the Ellensburg, Wash., Municipal Light Department to succeed CHARLES CULP, who resigned after holding the position for three years. He has been assistant superintendent since last May, when he joined the department after serving as a captain in the Corps of Engineers. Mr. Culp

will continue with the city as head of the billing department for both light and water utilities and will be placed in charge of maintenance and collection for parking meters when they are installed on the city's streets early next year.

•

New Assignments Made by General Electric Co.

Many new appointments have recently been announced by the General Electric Co.

Dr. Winton I. Patnode, chemist on the staff of the General Electric Research Laboratory at Schenectady, has been placed in charge of the Hanford Branch of the laboratory at Richland, Wash. Operation of the Hanford Engineer Works was taken over last fall by General Electric.

A. W. Gilmore has been appointed manager of a new wire and cable division, H. L. Andrews, vice-president in charge of the company's appliance and merchandise department, has announced. The new division is a consolidation of the former York (Pa.) wire and cable division and the Bridgeport wire and cable division. Mr. Gilmore joined the G.E. organization in 1926. In his new position, he is responsible for engineering, manufacture and sales of the wire and cable division.

Horace Zimmer has been named manager of the apparatus department, New York district. Mr. Zimmer succeeds T. F. Barton, commercial vice-president, who will devote full time to his duties as a member of the staff of Charles E. Wilson, president. Mr. Zimmer has had wide district sales experience with the organization and since last July has served as assistant manager of the apparatus department, New York district.

D. E. Craig has been appointed manager sales of the unit substation section, unit equipment division. Before joining G.E. in 1936, Mr. Craig was connected with the Northern States Power Co., and with the municipal light department of Sioux Falls, S. D.

Robert W. Larson has been appointed administrative assistant to the director of the General Electric Research Laboratory at Schenectady. He has been identified with General Electric since 1922.

Three new appointments in the meter and instrument division of the apparatus department have recently been announced. Richard Cutts, Jr. has been named assistant manager; E. J. Boland, manager sales for the division's instrument section; and E. J. Wehrle, consultant of the instrument section. Mr. Cutts will also continue his duties

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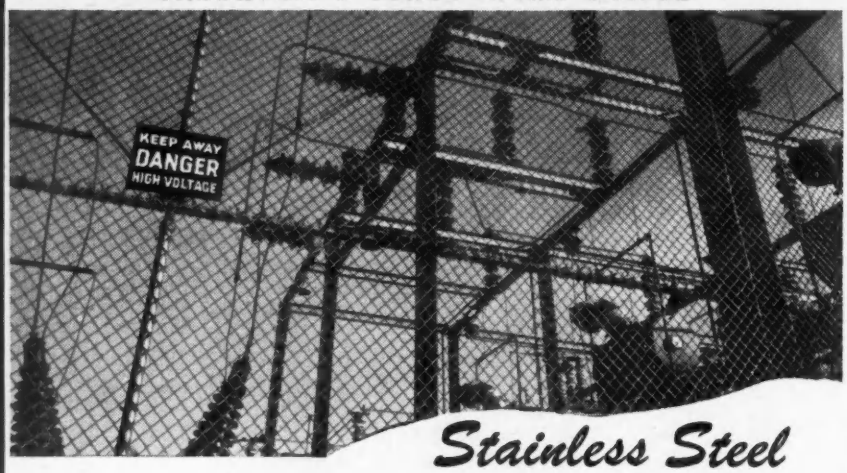

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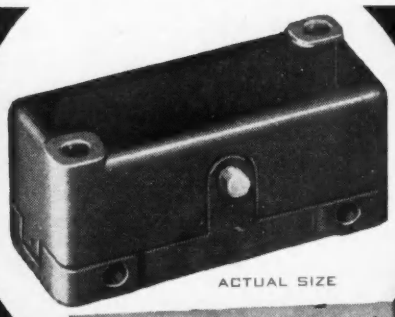

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as manager sales for the division's meter section.

N. R. Stansel, who has been with the General Electric Co. for more than 35 years, recently retired. In the past few years as an engineer with the company, Mr. Stansel has been associated with the development of electrical engineering to electrochemical and electrometallurgical processes.

OBITUARY

▶ Louis P. Orr, president and general manager of the Cleveland Electric Motor Co., died at his home in Cleveland on February 2. One of the organizers in 1914 of the company, which manufactures motors and electrical equipment, Mr. Orr became its executive head in 1932. He was born in Cleveland 60 years ago.

▶ George V. O'Reilly, 55, superintendent of distribution for the Lawrence (Mass.) Gas & Electric Co. since 1942, died in Lawrence on January 27. He was born in Lawrence and joined the company in 1909, becoming line foreman in 1928, from which position he was advanced to his late position.

▶ George H. Currie, formerly local manager for the Wisconsin Power & Light Co., Madison, Wis., died on January 22 at his home in Delavan. He was 89 years old. Mr. Currie spent 60 years of his life in active work in the electric industry. A native of Philadelphia, he went to Delavan in 1895 to supervise construction of the first electric generating plant built in that city for the newly organized Delavan Light & Fuel Co. Leaving Delavan, he became associated with other new electric companies in the Middle West, but he returned to Delavan in 1911 as manager for the United Heat, Light & Power Co., successor to the original company. With the acquisition of the Delavan property by the Southern Wisconsin company in 1915, Mr. Currie continued as manager, becoming identified with the Wisconsin Power & Light Co. in the same capacity with the purchase of the property in 1929. Retiring as local manager in 1934, Mr. Currie remained on the company payroll in an advisory capacity for sometime after. Early in his career he engaged in telephone work.

▶ Dr. Walter S. Rodman, dean of the engineering school of the University of Virginia, Charlottesville, since 1933, and a member of the faculty for 36 years, died on December 31 in the University of Virginia Hospital after an illness of four days. He was 63 years old. Dr. Rodman was born in Wakefield, R. I., and received his education at Rhode Island State College where

he later taught, and at the Massachusetts Institute of Technology. He served successively on the University of Virginia staff as adjunct, associate and then professor of electrical engineering, became acting dean of engineering and in 1933 dean.

▶FRANK I. DOANE, electrical and mechanical engineer for the California highway department for the past twelve years, died January 7 in Berkeley. He was 59 years of age.

▶ROBERT D. HEFLIN, sales manager of the Gisholt Machinery Co., Madison, Wis., and a former consulting engineer to the War Production Board, died on January 23 in Maplewood, N. J., He was 63 years old. Mr. Heflin was with the Gisholt company for 36 years and held the WPB post from 1941 to 1945.

▶CLARENCE H. ELLIS, division manager for the Florida Power & Light Co., West Palm Beach, Fla., died on January 3 at his home in that city after an illness of several months. He was 70 years old.

▶CHRISTIAN I. GUNNESS, 64, head of the agricultural engineering department at Massachusetts State College and an outstanding pioneer in the field of rural electrification, died at Amherst, Mass., on December 21. He was born in Abercrombie, N. D., and went to Massachusetts in 1914. His cooperation with electric utilities in the northeast in organizing farm service development covered over a third of a century.

▶HOYT D. GRIFFITH, district office manager of Westinghouse Electric Corp., Springfield, Mass., died in that city on January 4. Mr. Griffith was a graduate of Carnegie Tech and formerly was connected with Westinghouse at Pittsburgh, Buffalo and as sales engineer for five years at Providence, R. I. He was 60 years of age.

▶WILLIAM E. REED, consulting electrical engineer, died on January 25 in Pittsburgh. Following graduation from the Massachusetts Institute of Technology, Mr. Reed became chief engineer for Westinghouse in Paris, where he was located for five years. He went to Pittsburgh in 1904.

▶COLLAMER C. FOLGER, manager of the Kingston Public Utilities Commission plants at Kingston, Ont., for more than 35 years, died recently following a long illness. Mr. Folger began his career with the Kingston Light, Heat & Power Co., owned by his father. With the formation of the Kingston Public Utilities Commission in 1914, he was named general manager and served in that capacity until his death.

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MANUFACTURERS & MARKETS

Unprecedented Peace-Time Rubber Imports Swamp Ports Along Atlantic Seaboard

An unprecedented peace-time import of rubber is flooding New York and other Atlantic Coast ports, shipping companies recently disclosed.

Estimated January unloadings for all American ports will total some 80,000 tons, and by the end of March or mid-April the flow is expected to establish a six-month total of 350,000 to 400,000 tons. For the first time in the history of the trade with the East, ships are coming in with cargoes that are exclusively rubber and shipments of 6,000 and 8,000 tons are becoming commonplace.

Through the Reconstruction Finance Corporation, the United States Government is the sole importer of rubber. Future government buying plans are not yet announced, but shipping men expect the flow to continue. The estimated natural rubber production for the year, throughout the world, has been placed at 1,200,000 tons.

Government's Action Criticized

The government's recent action in increasing the price of crude rubber by 3¼ cents a pound was severely criticized by two major rubber companies. As a means of offsetting this "unjustified" increase, P. W. Litchfield, chairman of the board of the Goodyear Tire & Rubber Co., called for an immediate reduction in the government price of synthetic rubber from 18½ cents a pound to 16 cents.

RFC explained that it raised the price of crude because of a corresponding increase it paid for 150,000 tons contracted for last summer. This action, Mr. Litchfield charged, is "unnecessary and plays into the hands of the international speculators to the disadvantage of the American rubber consumer and industry." United States Rubber Co. characterized the RFC increase as "untimely and unfortunate" and one that "may set a pattern that will cost consumers millions of dollars."

Last June the United States entered into an agreement with other nations to buy 150,000 tons of rubber, as this country's share of June-December production. In the following month, as production expanded, we agreed to take another 200,000, with the understanding that in case of a deficiency in estimated production, we could fill the quota by purchases from London stocks.

Shipments Delayed

Most of the original 150,000 tons was in this country by December 31 and some of the Far East shipments of the second lot, somewhat delayed by bad weather, are being unloaded this month and should be completed by the end of February or early in March. A third buying program called for 50,000 tons for January shipment, and that also is delayed, but should be discharged by the end of March or the middle of April.

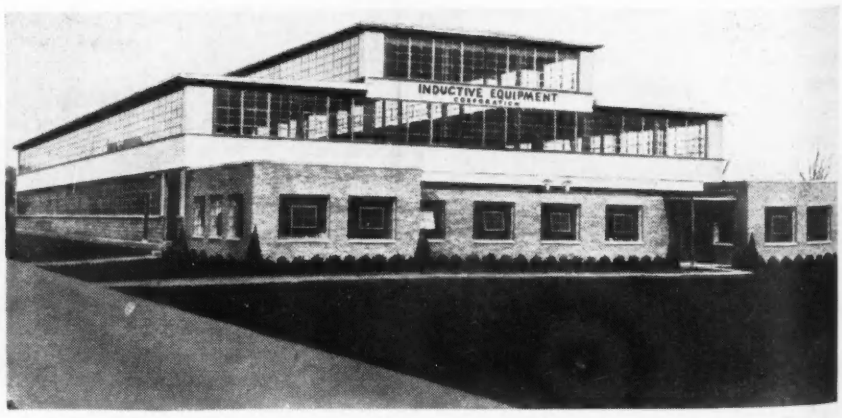
So large are the shipments that trouble is being experienced in handling cargoes on arrival, due to the lack of facilities. Port congestion in New York has already resulted in the diversion of thousands of tons of rubber to Boston, Baltimore and other port cities. With docks clogged with waiting export cargo, storage space is at a premium, according to reports.

Wisconsin Legislature Acts to Clear A-C Vote

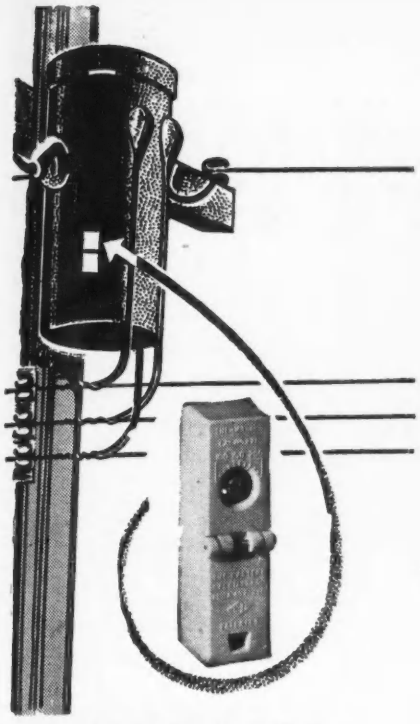
Wisconsin state senate last week passed a bill providing for run-off elections under employment relations board direction when a previous election failed to give any union a majority as a collective bargaining agency. The bill was requested by the state labor relations board as a result of the recent Allis-Chalmers non-conclusive vote. (ELECTRICAL WORLD, January 25, Page 5; February 1, Page 43).

The present law permits more than two unions to bid for recognition as bargaining agent at a single election and permits employees to vote against any kind of union representation. Under the bill adopted by the senate and now before the assembly, the board is empowered to hold a run-off election. It also authorizes the board to drop the name of the organization receiving the least number of votes in the original election or to drop the privilege of voting against all union representations "when the least number of votes cast at the first election was against representation by any named representative."

In the recent Allis-Chalmers election to determine whether Local 248, U.A.W.-C.I.O., or the Independent



NEW HOME — After operating for the past year in temporary quarters, the Inductive Equipment Corp. has moved into this new building at Gettysburg, Pa. The company will manufacture magnet wire, transformers, rectifiers, and various types of high-frequency equipment for utilities as well as for the radio, chemical and steel industries. The building, which contains 50,000 sq.ft. of work area, was formally opened in December at an open house with John R. Gaston, president and chief engineer, and W. A. Lanning, general engineer, as hosts



NOW!

QUICK, SURE WAY TO LEARN TRANSFORMER LOAD CONDITION

A quick glance at THERMALARM, and if the flag is red, there's danger! THERMALARM is a small unit attachable to your transformer, which trips a red flag when there's danger of load condition and shows you at a glance whether the transformer temperature is too high.

Utilities are praising the accuracy of THERMALARM and have placed many orders for them since they became available. They cost little—only $3 each—and will save you much! Place your order today for as many THERMALARM's as you need for your distribution system.

EASTERN SPECIALTY CO.

3617 N. 8th St., Philadelphia 40, Pa.

300 Guernseys and he's his own cow-hand...

Talk about riding herd—the owner of this farm can do it from his backyard. He depends on an electric cow-hand.

Charged fences keep many herds in pasture—just one example of how electrification has helped streamline farm work—save time and labor.

Power for many of these modern farms is carried on pole-lines equipped with Owens-Illinois Power Insulators. These glass insulators for electrical distribution systems are made under the most carefully controlled conditions by a pioneer company in the glass insulator field.

Principal jobbers carry stocks of Owens-Illinois Power Insulators and are making prompt shipments.

•

Every lot of Owens-Illinois Power Insulators is tested under methods set by American Institute of Electrical Engineers in specifications No. 41-1944 (ASA C 29-1944) and by the American Society for Testing Materials D-730-43T.

OWENS-ILLINOIS POWER INSULATORS

Owens-Illinois Glass Company, Hemingray Division, Muncie, Indiana

MANAGEMENT and PRODUCTION men want

FACTS

about equipment they buy

Here are FACTS about

Coffing Hoists

"SAFETY-PULL"
Ratchet Lever Hoists

For all kinds of construction and maintenance work, wherever a lift or pull is needed, there is a "Safety - Pull" to meet your requirements. SAFE, DURABLE, DEPENDABLE. Capacities range from ¾ to 15 tons, yet they weigh only 14 to 150 pounds.

"QUIK-LIFT"
Electric Hoists

For dependable and economical service the "Quik - Lift" incorporates EFFICIENCY with SPEED, POWER and DURABILITY. Just plug it in and speed up production. Capacities from 500 to 4000 pounds with lifting speeds from 4 to 49 feet per minute.

MODEL Y-C
Spur Geared Chain Hoists

Coffing Spur Geared Chain Hoists embody the planetary gear system with the Weston automatic brake. There are seven capacities ranging from ½ to 5 tons. A sturdy, dependable hoist for heavy work and in the production line.

Contact Your Supplier or Write for
BULLETIN EC-100

Coffing Hoist Co.
Danville, Illinois U. S. A.

Workers of Allis-Chalmers was the proper bargaining agency, neither received a majority. Local 248 received 4,122; the independent union, 4,015. However, 116 votes were cast for no union representation and 50 votes were challenged. It is not considered probable that Local 248 can salvage enough of the challenged ballots to obtain a clear-cut majority.

In the meantime, negotiations and attempts to settle the strike are at a standstill. The company is prohibited by state law from entering into negotiations with either group until the question of "who represents the workers" has been settled.

Normal Delivery Dates Currently Quoted

Normal delivery dates currently being quoted in the industry for nine types of apparatus range from immediate delivery on the lower capacity sizes of capacitors to 36 months for 25,000-kva. capacity steam turbines of conventional design. New orders are just about equal to industry output since current quoted dates are approximately the same as those first quoted in a spot survey made in November.

The industry is well in agreement on deliveries with minor variances due to individual problems. The spread in the table is due mainly to variation in delivery dates on various sizes.

NORMAL DELIVERY DATES CURRENTLY BEING QUOTED

	Months
Distribution Transformers	
1½ to 10 kva.	13 to 24
15 to 100 kva.	12 to 20
150 to 500 kva.	12 to 20
Power Transformers, 66-kv. and up	
under 5,000 kva.	15 to 25
5,000 kva. and up	22 to 30
Air, Oil Circuit Breakers	
2.3 kva. and under	12 to 20
2.3 to 66 kv.	10 to 20
66 kv. and up	18 to 23
Feeder Voltage Regulators	18 to 24
Steam Turbines, 25,000 kva and up	35 to 36
Watthour Meters	
Single Phase	7 to 13
Polyphase	8 to 9
Demand Meters	12
High Voltage Cable	4 to 8
Capacitors	0 to 6

Foreign Surplus Restrictions

Import restrictions on electrical equipment and supplies now held as surplus property by the Foreign Liquidation Commission have been lifted. General information on the location of the material is available from the FLC headquarters in Washington.

Foreign surplus is subject to none

HOW TO MAKE POLES LAST LONGER

Just off the press. A factual booklet describing 12 years field experience with OSMOPLASTIC in ground line treatment of standing poles as well as other timbers. Explains the Osmoplastic method of treatment in detail. Write for your copy.

OSMOSE WOOD PRESERVING CO. OF AMERICA, INC. 1437 BAILEY AVE., BUFFALO 12, NEW YORK

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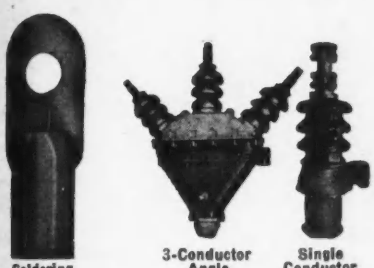
RMC

FOR HEAVY INDUSTRIAL SERVICE

FROM STOCK



Soldering Lug — 3-Conductor Angle Pothead — Single Conductor Pothead

Write for a complete selection of RUSGREEN bulletins

INSULATORS (POTHEADS) ALL SIZES • ALL SHAPES • ALL VOLTAGES • ALL TYPES • BUS SUPPORTS • SPLICING KITS AND MATERIALS • INSULATING COMPOUNDS

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PITTSBURGH DIVISION: Erie, Greensburg, and Pittsburgh, Pa.

Don't Shake Hands

WITH DEATH!

The electric chair penalty is no worse than taking chances by pulling fuses with bare hands. PLAY SAFE!

Use a TRICO

FUSE PULLER

- EVERY ELECTRICIAN SHOULD CARRY ONE
- HANG ONE AT EVERY SWITCHBOARD
- PUT ONE IN EVERY TOOL KIT
- PLACE ONE IN EVERY FUSE BOX
- USE ONE TO TIGHTEN FUSE CLIPS AND TO HANDLE LIVE ELECTRICAL PARTS

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TRICO FUSE MFG. CO., Milwaukee, Wis.

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FOR OUTAGE PROBLEMS ON RURAL LINES

★ *Locate Faults Faster*

★ *Restore Service Sooner*

with *Raytron* Electronic FAULT LOCATOR

You can locate ground faults within one span without climbing poles with the Raytron Electronic Fault Locator. Simply energize the circuit from the section break with a capacitor and carry the Raytron Locator along the line. At line intersections or lateral taps the locator meter will tell you which way to drive and point out the fault within one span. The Locator will operate up to 100 yards from the line.

The Raytron Method of tracing faults saves many hours locating ground faults on all types of overhead distribution lines. Invisible storm damage, damaged lightning arrestors and other hard-to-locate faults can be found quickly. Not affected by weather.

Get proof that Raytron Locator will locate faults faster and help you restore service sooner. Ask for a demonstration of Raytron Electronic Fault Locator. You will not be obligated. *Write Today.*

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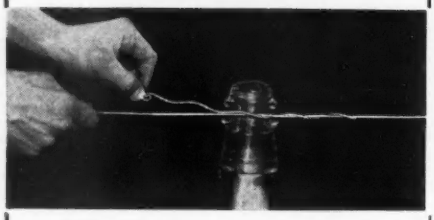
RAYTRON, INC. • JACKSON, MICHIGAN

STANDARD PREFORMED ARMOR RODS



No tools or clamps necessary! Quickly applied by hand! Dampens vibrations and protects conductor from flashovers and abrasions. Ideal for repairing broken strands of ACSR. Standard *Preformed* Armor Rods offer perfect protection for attaching hot-line clamps. Write or wire for complete information and find out why so many utilities are "Switching to Standard".

Standard Electric Company

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Economical . . . dependable . . . precision engineered for 100% satisfactory service.

FABRICATED TUBE PARTS

Standard or items for your special purposes.

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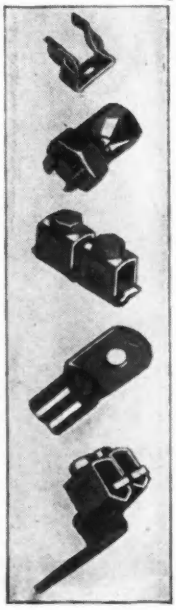
WRITE TODAY for 48-page illustrated catalog.



ILSCO COPPER TUBE & PRODUCTS, Inc. CINCINNATI, OHIO

of the priorities applied the domestic surplus. U. S. agencies are given the edge only when competing with private bidders for the same items at the same time. Otherwise goods are sold on a first come, first serviced basis, the commission has made known.

•

C.I.O. Union Revokes Charter of G.E. Local, Bridgeport

The general executive board of the United Electrical, Radio and Machine Workers (C.I.O.) revoked the charter of its General Electric local in Bridgeport, Conn., this week, for expelling 27 members on charges of communism.

Revocation of the charter of Local 203 resulted from a chain of events which started on February 2 when a membership meeting authorized the local executive board to oust from the union any persons who held membership in the Communist party or any other subversive group. Two days later the local leaders, who were elected on December 12 on an anti-Communist program, expelled 27 members, including several officers and shop stewards. Last week they received a letter from Albert J. Fitzgerald, national president of the union, ordering that the ousted members be reinstated.

When no action was taken on this demand, the 23 members of the union's general executive board were called to a special meeting early this week at its national offices in New York where by unanimous vote the board held that the expulsions violated clauses in the constitutions of the national and local organizations prohibiting political discrimination.

In its statement announcing withdrawal of the charter, the board said officers of the local would "receive every opportunity to be heard in defense of their illegal activities" at the board's next meeting in March. The board added that it had received a petition from "a substantial portion of the membership" calling upon the national union to intervene in the situation.

•

Roebling Employees to Buy Village Built for Them

A majority of the occupants of the 752 "company houses" in the village of Roebling, N. J., the population of which numbers 3,000, met the deadline set for February 1 with offers to purchase the homes they or their parents have lived in for 40 years as employees of the John A. Roebling's Sons Co.

Archibald W. Brown, treasurer of the Roebling company, said that a majority

ALL the strength and durability inherent in steel are combined—with definite economies—in *Crapo* Galvanized Steel Strand. Heavy, ductile, tightly-bonded zinc coatings, applied by the famous *Crapo* Galvanizing Process, provide lasting protection against corrosion.

Ask the distributor of *Crapo* Galvanized Products near you or write direct for further information!

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KEES Outdoor Meter Boxes

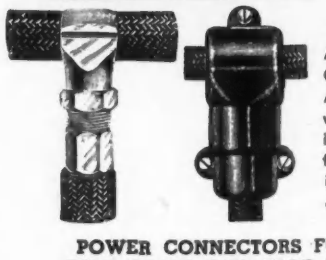
A size for every need.

Galvanized steel, baked aluminum finish. Designed for economical installation.

Write for catalog

F. D. Kees Mfg. Co.
Box 247
Beatrice, Nebr.

DOSSERT CONNECTORS



TYPE DHT
A hook type CABLE TAP Available with insulating cover for compact insulated connections.

POWER CONNECTORS FOR TUBE CABLE AND FLAT BAR

DOSSERT MANUFACTURING CORP.
249-254 Hugon St. Brooklyn, N. Y.

Give your crews the

Protection

of this

STURDE Guarded Pike Pole

The patented, automatic shield on this SturdE pike pole is a safety feature for your men—an economy feature for you. The seamless steel tube slides down to protect the point when not in use, guards it against damage and prevents accidents to crews. When action starts, the guard slides back, and *locks* to reinforce the ferrule and give added strength.

The 8¼ in. spike is forged from high grade steel, heat treated and tempered for hard service, and can be easily repointed. The fir handles are sanded and lacquered, and come in five lengths, 12 to 20 feet.

Here's a sturdy, long-life tool with a safety feature that adds extra value. Manufactured by The American Fork and Hoe Company, Cleveland, Ohio, Makers of True Temper Products.

STURDETOOLS
a TRUE TEMPER PRODUCT

Exclusive SturdE feature — Automatically released tubular shield is easy to operate, locks into place and reinforces head when pole is in use. Slips down to protect point for carrying and storing.

Distributed by
JOSLYN MFG. & SUPPLY COMPANY
20 North Wacker Drive • Chicago, Illinois
Branches and Warehouses with Complete Stocks in Principal Cities of the United States

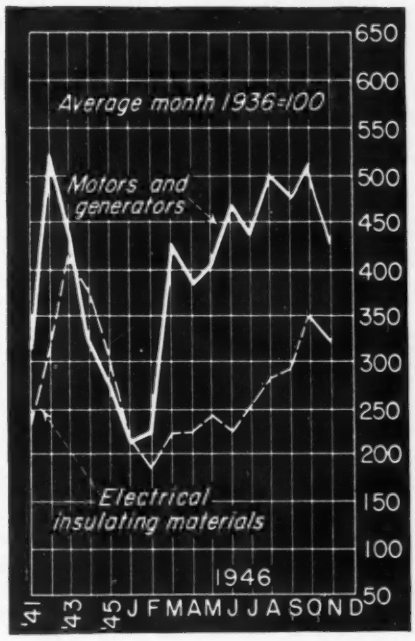
of the townspeople are paying cash for their homes, while others are financing the purchase through the Federal Housing Authority or their banks.

The residents have been paying the company from $18 to $30 a month rent for these single and double brick dwellings, ranging in size from four to nine rooms. They were sold to their occupants at prices ranging from $3,000 to $6,500 while three more pretentious homes were sold to company officials at $16,000.

•

Generator Orders Decline; Insulating Materials Drop

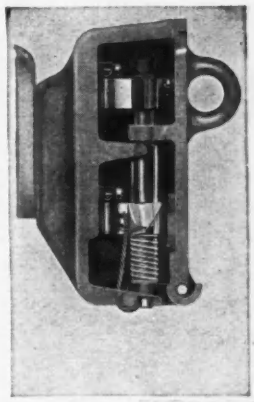
Orders received for motors and generators during the month of November, 1946, decreased, according to figures



released by the National Electrical Manufacturers Association. The index compiled by NEMA dropped to 438 from 508 (revised) in October, a decrease of 14 percent. This figure, however, represents an increase of 72 percent over November, 1945, when the index stood at 254.

The 1942-1945 monthly indexes include an adjustment for cancellations reported up to December 31, 1945. No adjustment has been made for renegotiation of contracts. Singe-phase, integral-hp. motors have been added to the series beginning with the month of January, 1944. Fractional-hp. motors are not represented in this index.

Sales billed on electrical insulating materials for November also dropped in November, 1946, the index moving downward to 331 from 351 (revised) in October. This compares with 202 in November, 1945, this year's figure representing an increase of 64 percent.



Dropdown Indicating
MATTHEWS CUTOUTS.

SAFER,
if closed in on short because it is tripfree.

COOLEST,
because of good old fashioned pressure-area contacts. Contacts free from radio noise.

PATENTED SLACK REMOVER,
will automatically take up ⅜ inch of slack fuse link which prevents false outages, and burned contacts.

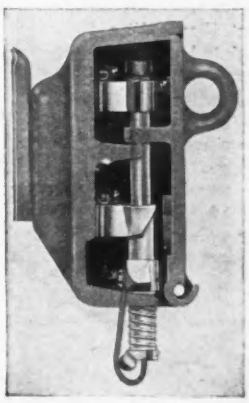
ALWAYS INDICATES
when fuse link parts—even if door is frozen shut. See drawing below.

NORMAL TENSION
on link is less than 2½ lbs., therefore over-stressing or breaking of links is impossible.

YEARS
of successful service for many thousands prove their efficiency.

Try Them At Our Risk.
Write For Complete Bulletin.

W. N. MATTHEWS CORPORATION
ST. LOUIS, U. S. A.



WARNING SIGNS THAT "STAY PUT" ... won't blow over

"Cope" Warning Signs are extremely rugged with welded steel frame and steel panel. The legs lock in the open position and fold as compactly as a card table, requiring a minimum of space. Each sign weighs approximately 25 pounds and will not blow over or collapse when placed squarely in position.

The sign illustrated stands 30" high and 18¾" wide with an 18" x 18" panel painted with 5" letters. Quotations on these or specially painted panels may be had on request.

Write for catalog and price list of complete "Cope" line.

T. J. Cope Inc.
6120 Vine Street, Philadelphia 39, Pa.

CABLE INSTALLATION & MAINTENANCE TOOLS & EQUIPMENT

We at Flexo Wire Co., are well acquainted with the numerous advantages of wire and cable that have controlled flexibility. This versatile feature is designed to render improved efficiency and performance. Your specifications for heavy-duty, long wearing uninsulated wire and cable can be easily solved by writing to Flexo Wire Co., and asking for catalog #62.

Flexo Wire Company
70 W. FIRST STREET OSWEGO, N. Y.

Recent Rate Changes

CONSOLIDATED GAS ELECTRIC LIGHT & POWER CO. of Baltimore filed amended schedules of electric rates last month with the Maryland Public Service Commission. The commission, ruling that the new schedules represented a "just and reasonable distribution" to effect a $3,650,000 cut in gross annual electric operating revenues, has just approved the new schedules. It directed that the new schedule become effective with April, 1947, meter readings. Furthermore, all industrial gas and electric consumers who have heretofore been billed on a calendar-month basis shall, the PSC directed, be billed for service furnished on and after April 1, 1947, under the amended schedules for electricity and under new schedules for gas authorized by the commission on December 30. Since the commission previously approved an increase of $150,000 in steam rates and $2,500,000 in gas rates, the net reduction to all consumers in all three services, including electricity, will run to $1,000,000 a year.

KENTUCKY UTILITIES CO. has announced that on March 1 it will reduce street-lighting rates with a resultant annual savings of $27,500 in cities served by the company.

•

Manufacturers Make Sales Assignments

Electrical manufacturing companies have recently made the following appointments to their sales staffs:

PACIFIC ELECTRIC MFG. CORP., San Francisco, has appointed Edgar F. Hubert Co., 936 Statler Bldg., Boston, Mass., sales agent in that territory.

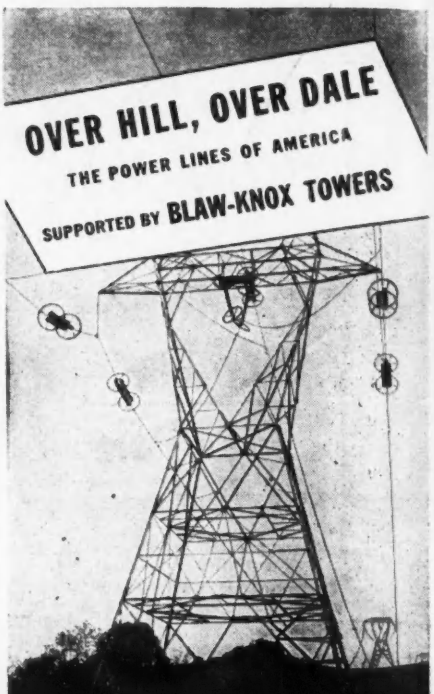
DUNCAN ELECTRIC MFG. CO., Lafayette, Ind., has named Charles C. Blecksmith as western district manager, succeeding his father, the late Arthur F. Blecksmith, with offices at 164 South Central Ave., Los Angeles 12, Calif.

ADMIRAL CORP., Chicago, has appointed Harold D. Conklin as northwestern sales manager for all Admiral products, with headquarters in San Francisco.

AMERICAN MFG. CO., Brooklyn, N. Y., has named Benjamin Gratz, Jr., southern sales representative, covering the states of Florida, Alabama, Georgia and South Carolina.

BULLDOG ELECTRIC PRODUCTS CO., Detroit, has assigned F. E. Bush to the Cincinnati branch office in the capacity of field engineer. He handles the Kentucky portion of the Cincinnati territory with headquarters in Louisville. Don C. Thomson has also been assigned to the Cincinnati branch office in the capacity of field engineer.

ALLIS-CHALMERS MFG. CO., Milwaukee, has named Paul R. Pollock manager of the Denver, Colo., office. Henry H. Roth, whom Mr. Pollock succeeds at Denver, has been transferred to generator sales of the motor generator sales section of the electrical department at the company's main works. E. T. Cuddeback, who spent five years in the Army Air Forces, is now representing the company out of the Atlanta, Ga., district office.



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you can
and
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SubaLox
LEAD AND ALUMINUM PAINT
Spot or Full Coat
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It sticks, it blends.
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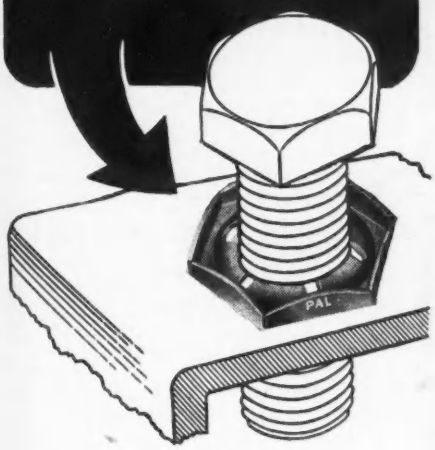
NORTH ARLINGTON, N. J.

Use
PALNUTS
to lock
Adjusting Screws
on Relays and
Circuit Breakers



Hold Accurate Settings under Severest Vibration

An adjusting screw that won't "stay put", is soon valueless. To maintain accurate settings of adjusting screws, lock them with Palnuts instead of regular hex nuts or jam nuts. This provides a powerful double-locking action that is unmoved by severe, prolonged vibration.

Single thread, tempered spring steel Palnuts require only 3 bolt threads space. They spin on fast with fingers, lock tight with 1/4 to 1/3 turn of a wrench. Cost no more, and frequently less, than regular nuts. May be re-used. Full line of sizes in National Coarse and National Fine Threads.

WRITE for literature giving engineering data on Self-locking Palnuts. Outline requirements for samples.

THE PALNUT COMPANY
51 Cordier St.
Irvington 11,
New Jersey

SELF-LOCKING
PALNUTS

LETTERS TO THE EDITOR

Substation Span Sags

To the Editor of ELECTRICAL WORLD:

In the article "Strain Insulator Effect in Substation Span Sags," (ELECTRICAL WORLD, July 6, 1946, pages 62-63) the author calculates the effect of strain insulators on short span sags, assuming the insulator strings to be flexible and that they take the form of the catenary. Calculations such as these may be made with equal accuracy by assuming that the insulator strings are rigid and take the form of a straight line. Adequate accuracy may be had by use of a slide rule; the use of tabulated hyperbolic functions is dispensed with.

Derivation of the necessary formulae and calculation of Mr. Stover's example follow.

Assuming half the weight of the insulator string concentrated at either end of the string, Fig. 1 shows the forces acting at the end of the insulator string.

From an inspection of Fig. 1 we have

$$T = \sqrt{H^2 + V^2} \qquad (1)$$

$$\text{and } D = \frac{V}{T} \times L \qquad (2)$$

$$\text{Let } d = T - H \qquad (3)$$

Combining Equations (1) and (3) and simplifying

$$d = \frac{V^2}{2H + d} \qquad (4)$$

Equation (4) may be further simplified without loss of accuracy to read

$$d = \frac{V^2}{2H} \qquad (5)$$

and thus

$$T = H + \frac{V^2}{2H} \qquad (6)$$

Applying the data in Mr. Stover's

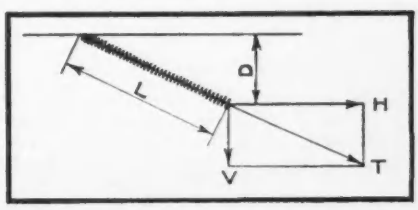


FIG. 1—Tension components fix angle to insulator string

L	= Length of insulator string	Ft
D	= Insulator sag	Ft
H	= Horizintal conductor tension	Lb.
$V = \frac{I}{2} + C$		Lb.
I	= Total weight of insulator string	Lb
C	= Weight of conductor supported (i.e., from end of insulator string to low point of span)	Lb.

SUPERIOR

SINCE 1923

The name SUPERIOR has stood for top quality meter testing and installation equipment — built specially for the

UTILITY INDUSTRY

SUPERIOR
SWITCHBOARD & DEVICES CO.
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A subsidiary of The Union Metal Manufacturing Co.

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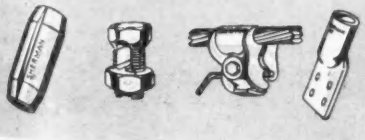

example to Equations (6) and (1), we obtain D = 0.245699 ft. compared with 0.245686 ft. obtained by Mr. Stover using catenary equations.

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Maurice Landau
Transmission-Line Design Section
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Long Memory

To the Editor of ELECTRICAL WORLD:

Something in the neighborhood of 16 years ago you extended my subscription for a few months for which I did not pay you. As I remember it was about $2.00 or $2.50 so you will please find enclosed my check (No. 187) in the amount of $2.50 for payment.

Thanking you, I am

Yours very truly,
W. A. Brewer
West Plains, Mo.

▶ Diogenes please note!

•

Seattle Makes Amicable Settlement with I.B.E.W.

Following a conference between members of the Seattle (Wash.) City Council and leaders of Local B-77 of the International Brotherhood of Electrical Workers, A. F. L., Mayor William F. Devin announced that the City Light Department's labor problems were assured of amicable settlement on a basis which avoids any threat of work stoppage.

The union had asked for formal recognition as the official collective bargaining agency for its approximately 700 members employed by City Light. The council declined to extend such recognition.

"It was agreed that the union will outline in full its grievances, and any which Light Superintendent E. R. Hoffman does not have power to settle will be taken directly and promptly to the council for consideration," Mayor Devin said.

•

P.U.D. Gives Pay Increase

Wage increases of 6 percent, plus 8 cents per hour, for operating personnel of the Cowlitz County (Wash.) Public Utility District have been approved in an agreement between the district and the I.B.E.W. The agreement is retroactive to January 1, and provides a minimum wage in the system of $1.22 an hour for production employees, with a paid holiday clause.

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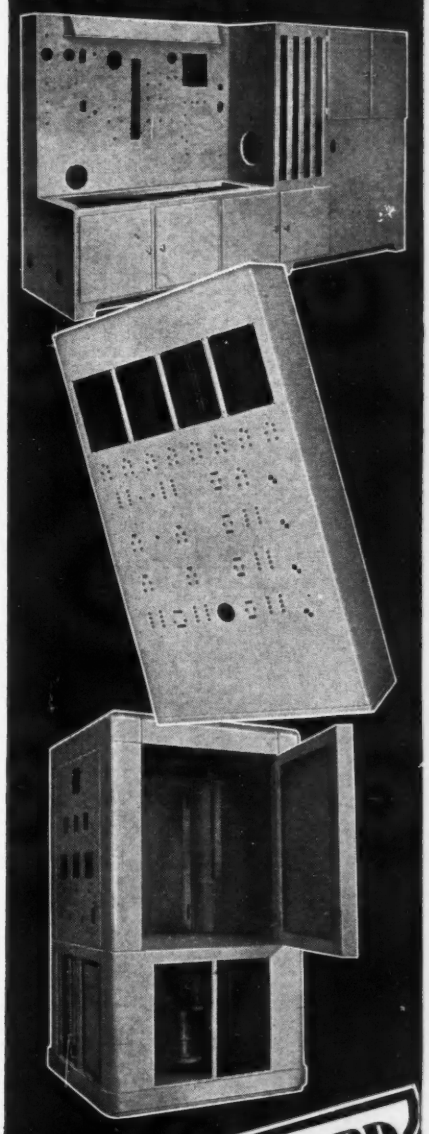

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POSITIONS VACANT

WANTED—ELECTRICAL Engineers for power station and substation design by consulting engineering firm. Location mid-west. P-450, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

ELECTRICAL ENGINEERS: experienced in design of substations, power plants or overhead and underground distribution systems. Desirable living conditions in fine home community. Write to Electrical Engineer, Pennsylvania Power & Light Co., Allentown, Pa.

DISTRIBUTION ENGINEER required by large public utility Brazil. Must be graduate engineering college or equivalent and have at least five years experience on systems similar to that Brazil which includes 13.2 kv 3.8 kv overhead and underground distribution and 20 kv underground sub-transmission. Please give full details education, experience, references and approximate salary required. All replies treated as confidential. P-442, Electrical World, 330 W. 42nd St., New York 18, N. Y.

WANTED: THREE Qualified Registered Engineers who are experienced in Power Transmission and Distribution Line Design and Construction. We have permanent employment for the right men. Work to be undertaken is in Minnesota, North and South Dakota. Please give statement of qualifications and experience together with references in your first communication. P-457, Electrical World, 520 N. Michigan Ave., Chicago 11, Ill.

WANTED GRADUATE Electrical Engineer with at least two years practical operating experience. Must be under 35 years of age. Permanent position with well known electric utility located in Northwestern Ohio. Immediate opportunity for advancement. Submit full particulars and salary requirements to P-458, Electrical World, 520 N. Michigan Ave, Chicago 11, Ill.

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INDIA Great sales opportunity for an aggressive American manufacturer of electrical appliances. This 100% Indian firm capable of getting complete distribution in South India. Write—S. S. Mohadevan, 250 Goods Shed St., Madura, Madras, India.

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Experienced graduate engineer, capable complete design of high voltage transmission lines, including lightning protection, economic selection of voltage, conductors and structures, and preparation of estimates of cost, specifications and plans for installation. Qualifications and Experience Record should be submitted with letter of application.

P-332, Electrical World
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UNDERGROUND ENGINEER

Graduate electrical engineer, with at least eight (8) years' experience in design of underground distribution and transmission systems. Applicants should be capable of selecting most suitable types of insulations and coverings for underground cables. Experience with underground and submarine cables above 33 kv desirable. Please furnish Experienced Record and personal data with application.

P-333, Electrical World
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We have a number of very attractive opportunities in the Philadelphia area for graduate electrical engineers who have had substantial practical experience in power house and power plant design, industrial plants, sales, etc. Also very much interested in electrical and mechanical design draftsmen.

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